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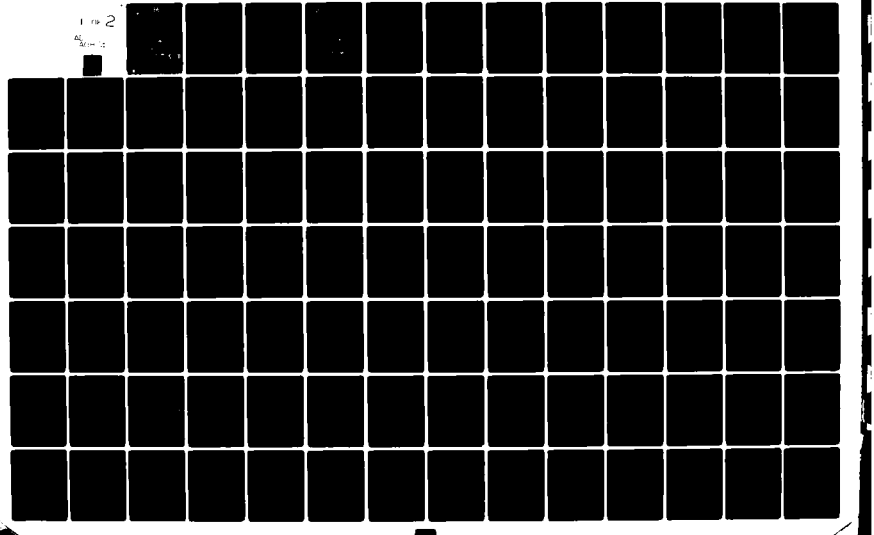

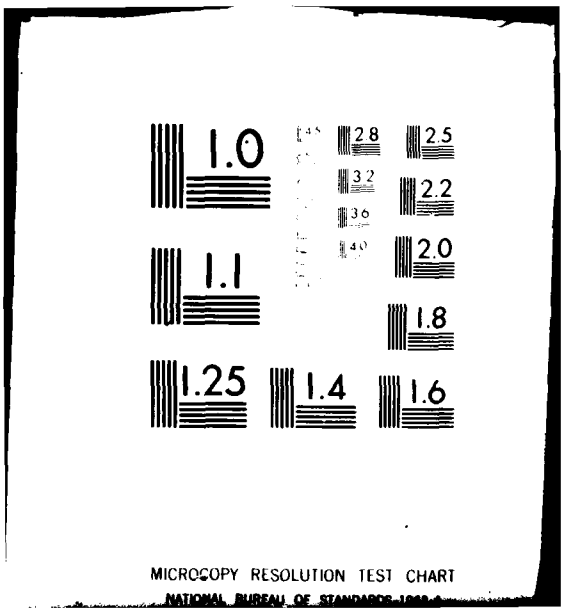
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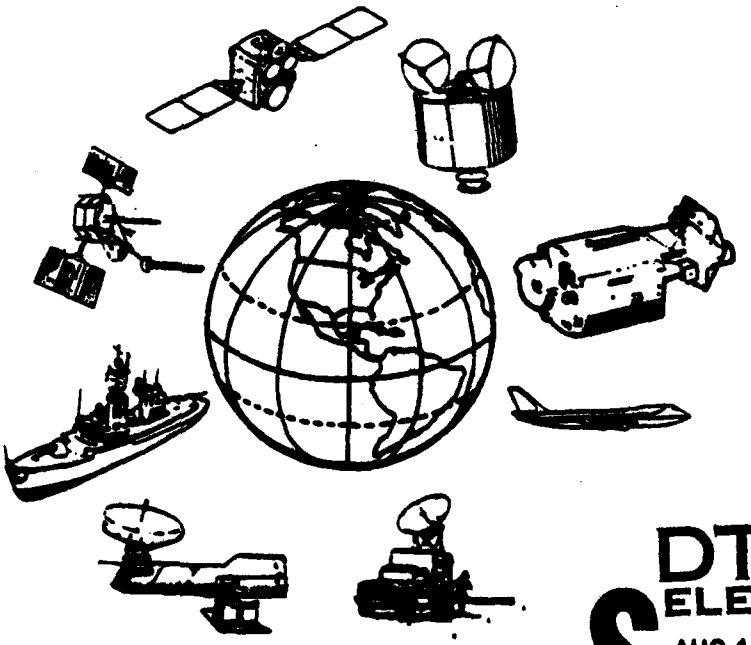
MILSATCOM SYSTEMS OFFICE

TECHNICAL REPORT NO. 80-1

LEASE VERSUS BUY CONSIDERATIONS FOR MILSATCOM SYSTEMS AND AN ACQUISITION STRATEGY FOR STRATSAT

SHORT TITLE: SSS LEASE/BUY STUDY



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APRIL 1980

UNCLASSIFIED (Code 820, 30 April 1980)

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: DCA/MSO Technical Report No. 80-1	2. GOVT ACCESSION NO.: AD-A087411 / 3. RECIPIENT'S CATALOG NUMBER:
4. TITLE (and Subtitle): Lease Versus Buy Considerations for MILSATCOM Systems and An Acquisition Strategy for STRATSAT (SSS Lease/Buy Study).	5. TYPE OF REPORT & PERIOD COVERED: Final rept.
	6. PERFORMING ORG. REPORT NUMBER:
7. AUTHOR(s): Leonard G. Larson; Ralph L. Spaulding, CAPT, USN	8. CONTRACT OR GRANT NUMBER(s): DCA/MSO-78-R-77-1
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Defense Communications Agency, MILSATCOM Systems Office, Code 820, Washington, DC 20305	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 12 99
11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE: Apr 1980 / 13. NUMBER OF PAGES:
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED / 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report)

Unlimited.

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Review Reference five years from submission date.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Lease versus Buy, Acquisition Strategy, STRATSAT, SSS, Cost Analysis, Cost Comparison.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report examines the lease/buy question as it applies to MILSATCOM systems to illuminate the issues involved and identify the factors that tend to drive a decision toward one or the other acquisition method. The report is organized into five sections: (1) Lease vs. Buy Considerations for MILSATCOM Systems--a tutorial on the various aspects pertaining to lease vs. buy considerations, (2) Acquisition strategy for STRATSAT--discussion of four possible acquisition strategies to acquire STRATSAT, (3) Comparative Cost

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20. Analysis of STRATSAT Lease vs. Buy Options--discussion of methodology and results of the lease vs. buy cost comparisons, (4) Contractor Responses to Leasing STRATSAT--review of contractor positions and views related to the practicality and feasibility of leasing STRATSAT, and (5) Appendixes--description of leasing arrangements for GAPFILLER, LEASAT, and TDRSS.

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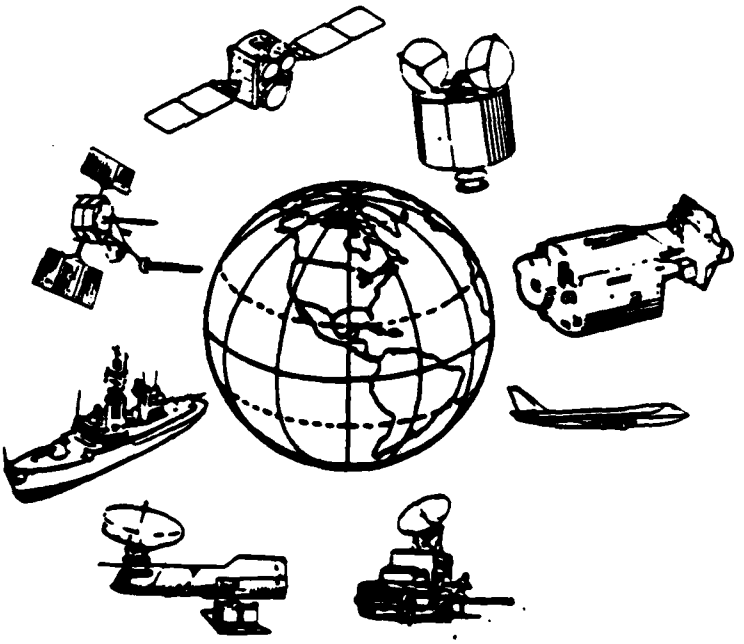

DCA MSO CODE 820
APRIL 1980

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EXECUTIVE SUMMARY

This report examines the lease/buy question as it applies to MILSATCOM systems to illuminate the issues involved and identify the factors that tend to drive a decision toward one or the other acquisition method. The report is organized into five sections: (1) Lease vs. Buy Considerations for MILSATCOM Systems--a tutorial on the various aspects pertaining to lease vs. buy considerations, (2) Acquisition strategy for STRATSAT--discussion of four possible acquisition strategies to acquire STRATSAT, (3) Comparative Cost Analysis of STRATSAT Lease vs. Buy Options--discussion of methodology and results of the lease vs. buy cost comparisons, (4) Contractor Responses to Leasing STRATSAT--review of contractor positions and views related to the practicality and feasibility of leasing STRATSAT, and (5) Appendixes--description of leasing arrangements for GAPFILLER, LEASAT, and TDRSS.

This report shows that the overall lease cost is expected to be higher than the buy cost because of expenses associated with financing and profit of the lessor. Parametric analyses show that exceptions to this can occur under unique conditions. However, no actual experience can be sited to illustrate the case. The LEASAT program comes the closest to illustrating the exception in that the lease cost quoted by the lessor was lower than the Government estimates for both the lease and buy acquisition strategies. However, no bid was received for the buy alternative to permit a direct comparison.

LEASE VS. BUY CONSIDERATIONS FOR MILSATCOM SYSTEMS

Notwithstanding the expected Lease/Buy cost differential, it is concluded that a satellite project may be a viable candidate for leasing when the technologies involved are sufficiently well developed that (a) a firm-fixed-price contract is appropriate and (b) the risk of failure can

be quantified adequately to allow that risk premium to be incorporated into lease rates. If the project involves technological risks that mandate cost-reimbursable rather than fixed-price contracting, then a lease is not likely to be feasible.

An actual decision to lease is appropriate when both of the above conditions are met and the overall program cost to the Government is lower than it would be under a buy strategy (cost comparisons are made using OMB Circulars A-76 and A-94 as implemented by DoD Instructions 4100.33 and 7041.33, respectively). Alternatively, a lease decision would be appropriate if it is desired to spread the cost of a system over the life of the system rather than paying for it all at the beginning of the program, regardless of the overall program cost.

The following is a summary comparison of the lease/buy aspects for acquiring MILSATCOM systems. (Note that many factors appearing under the lease column also apply to fixed price procurement. The buy column tends to reflect cost-plus type acquisition factors.)

	Lease	Buy
Technical		
	Performance specifications written in terms of service.	Specifications written in terms of equipment design or performance characteristics.
	Contractor may be able to optimize design to provide service without detailed justifications/reviews with Government.	Design may be changed, by contractor, but may involve many layers of review and approval.
	Fixed price specifications are frozen at time of contract award making for a smoother running program with less chance for delay. However, freezing design prohibits Government from changing the system to meet changes in requirements.	Design may be changed to meet changes in requirements at extra time and cost. Program delays may require management attention.

	Lease	Buy
Funding		
	Generally uniform cash flow of O&M funds over lifetime of system.	Major outlay of procurement funds early in program and over relatively short term.
	Lessor may be able to buy satellites at a lower cost than Government due to less review and fewer unique specifications and tests.	Government procurement costs tend to be higher due to management reviews, tight specifications, and extensive testing.
	Total cost is generally higher due to insurance, cost of capital, and return on investment to lessor.	Government has no insurance program nor return on investment considerations. There is no actual cost of capital but is imputed in cost analysis.
	Investment tax credits and deferred taxes tend to lower effective interest rate on loans.	There are no investment tax credits for bought system. Deferred taxes are not an issue.
	Total payment is in the form of in-orbit performance incentives. Thus, the lessor is gambling 100% of his income on product performance.	Government typically dedicates 10-15% to in-orbit performance incentives. Thus, the vendor is gambling only 10-15% of his income on product performance.
	Capital financing may not be possible without Government guarantees.	Capital financing is not required.
	Termination liability would typically be structured to guarantee the lessor some reasonable return for his efforts and loss of potential profit.	Termination liability limited to sunken development and production costs.
	Lessor assumes financial risk for successful performance. However, degree may be limited or minimized through negotiation or financing arrangements that shift more risk to the lessee.	Government assumes financial risk for successful performance.

	Lease	Buy
Management		
	Possible reduction in management effort by Government personnel.	Usually higher involvement by Government management personnel because of added acquisition responsibilities.
	Government has little management control over the system development.	Government has full management control over the system development.
	The satellite sparing philosophy is determined by lessor and is a function of the risk he is willing to accept.	The Government determines satellite sparing philosophy based upon availability requirements.

ACQUISITION STRATEGY FOR STRATSAT

The STRATSAT System has been defined for a highly unique, dedicated mission requiring a radiation hardened, highly maneuverable spacecraft in an orbit never used before as a mission orbit. In addition, the USAF expects to operate the system on a day-to-day military basis through operational ground stations and/or airborne command posts.

Four potential candidate acquisition strategies have been developed to provide the required satellite communications capability for STRATSAT:

1. Buy Strategy
2. Lease Strategy
3. Hybrid Lease-Funded Validation Phase
4. Hybrid Lease-Funded Development Phase

The two hybrid lease strategies retain some of the Government/contractor technical management relationship of a "pure" lease, but would provide some initial funding of the contractor to ease

the financial burden of a "pure" lease thereby making these strategies more amenable to a prospective contractor.

It is recommended that a lease-vs buy decision not be made at this time and that the Government fund contracts for the Validation and Full-Scale Development phases. The funding of these first two phases should be provided for with R&D funds starting in FY 1981.

It must be noted, however, that until the final decision is made to lease or buy, advanced funding of the Production phase is not well defined. If a buy strategy is chosen, then Procurement funds should start in FY 1983. However, if a lease strategy is chosen, then O&M funding would not be required until FY 1987 under the present schedules.

COST ANALYSIS OF STRATSAT LEASE VS. BUY OPTIONS

A comparative cost analysis has been conducted for the lease and buy options to acquire the satellite communications service of STRATSAT. The four candidate acquisition strategies for STRATSAT were analyzed. The cost analyses were conducted in accordance with OMB Circulars A-76 and A-94 as implemented by DoD Instructions 4100.33 and 7041.33, respectively.

The A-94 analysis considers a buy cost profile which very closely approximates the actual flow of funds. The development, launch, and satellite costs are represented as they would be expended. This is in contrast with the A-76 methodology wherein the satellite costs are depreciated over the service period thereby more closely approximating a lease arrangement.

The A-94 cost comparison is done on the discounted costs rather than the actual time phased dollar expenditures as under A-76. The discounted costs normalize all expenditures to a common base year (FY 81) thereby

factoring out the time value of the money. In this way the A-94 methodology in effect is comparing funds of equivalent buying power. Note that since the A-76 analysis is based upon undiscounted dollars and the A-94 analysis is based upon discounted dollars, a direct comparison between the results of the two methodologies is not meaningful.

The primary analysis was conducted with the assumption that the commercial costs to acquire satellites are the same as for the Government and that a lessor's return on investment is 15%. The A-94 analysis used the 10% discount rate prescribed by OMB Circular A-94. The results of the analysis are shown in Table ES-I for the A-76 methodology and Table ES-II for the A-94 methodology. These results clearly indicate that each of the lease options will cost more than the buy option even when a new start cost margin of 19% is considered under A-76.

TABLE ES-I
A-76 COMPARISON OF TOTAL COSTS
(Current Year $M)
(Return on Investment = 15%)

Adjusted Buy	Pure Lease	Funded Val	Funded Dev
1042	1269 (+22%)	1228 (+18%)	1123 (+7%)

TABLE ES-II
A-94 COMPARISON OF DISCOUNTED COSTS
(Discount Rate = 10% (FY 81))
(Return on Investment = 15%)

Buy	Pure Lease	Funded Val	Funded Dev
454	558 (+23%)	549 (+21%)	529 (+16%)

In addition to the primary analysis, parametric analyses were conducted to determine the effects of changing some of the more important factors. These included:

- o Commercial costs = 90% of Government costs to procure the satellites and the timing is one year less.
- o Return on Investment of 10%, 15%, and 20%.
- o Discount rates of 7.5%, 10%, and 12.5%.

These parametric analyses show that the overall lease cost is expected to be higher than the buy cost except under unique conditions.

CONTRACTOR RESPONSES TO LEASING STRATSAT

In February 1980, Air Force Space Division issued a letter to industry requesting comments concerning the financial impact and practicality of leasing STRATSAT. Responses were received from six communications satellite manufacturers (Ford Aerospace & Communications Corporation, General Electric Company, Hughes Aircraft Company, RCA, Rockwell International, and TRW) and one commercial satellite leasing company (Comsat General Corporation). Table ES-III summarizes these responses.

TABLE ES-III

SUMMARY OF CONTRACTOR RESPONSES

CONTRACTOR	PARTICIPATE IN LEASE	COST ESTIMATE	COMMENTS
Ford	Leasing satellites has not been part of Ford's business plan and they have no plans to change this plan.	None	None
GE	Strongly opposed to any leasing concept for STRATSAT.	Did not feel it was necessary to carry out, in meaningful detail, an analysis of cost differences.	Hybrid lease would remove some of initial development risk and would reduce front end development financing. However, it does not significantly reduce the risk attendant to operational on-orbit performance.
Hughes	A leased services offering, in either the pure or hybrid sense, would be inappropriate for this program.	A responsible contractor either could not arrive at a logically derived price for the pure lease or would have to incorporate a large risk premium and make it not economically advantageous.	Hybrid lease/buy is only partially effective in reducing real risk and consequent price premium.
RCA	Willing to participate if Government willing to pay costs of financing charges or use FFB.	A buy would probably be less expensive.	Strongly recommends that the engineering design, development, production, and test of first flight model be on a cost reimbursable basis. Lease or buy could follow.
Rockwell	Would not elect to participate in the STRATSAT program if it were structured on a conventional lease basis.	Government cost to acquire STRATSAT through leasing to be 40% higher than purchasing.	Large investment jeopardizes financial health of company. Large initial investment make it an unattractive opportunity. Financial risks threaten contractors continued viability.
TRW	None of the leasing arrangements suggested are in the best interest of either the government or spacecraft contractors and that a normal buy is appropriate. Most likely would elect not to respond.	Lease cost would be 1.6 times as much as buy.	The projected high research and development content is not consistent with leasing conditions. Lease would limit number of competitors.
COMSAT	Are led to conclude that a lease can be developed which is quite attractive to both the Government and private industry.	Unable to develop any actual program costs which would be meaningful.	Do not regard the two-phased approach as being particularly efficient from either the cost or performance standpoints.

LEASE VERSUS BUY CONSIDERATIONS FOR MILSATCOM SYSTEMS

INTRODUCTION

The major objective, whether DoD leases communications service or buys satellites for military communications, is to provide continuity of communication service for the military user. There are two major methods of providing the required service: (1) the direct military procurement method, whereby requirements are established and the DoD appropriates the necessary funds to procure the equipment to meet those requirements; and (2) the leasing strategy, whereby requirements are specified to the lessor who in turn provides the equipment and/or service. When a satellite is purchased, the contractor delivers a product to the Government's design specification, and the principal risk of failure is the Government's. By contrast, a lease normally puts 100% of the contractor's investment and potential revenue at risk in-orbit since lease payments typically would stop upon failure of the satellite. In addition to the risk issue the primary differences between the two acquisition methods are the financing arrangements and the amount and type of Government involvement. These factors, in turn, are a function of the type of lease involved, and are discussed below.

LEASING

General

A lease can generally be defined as a payment of money by the lessee to the lessor for equipment or services to be provided by the lessor to the lessee. The IRS has indicated that in order for a venture to be approved as a lease for tax purposes, the equipment owner must have title, and the owner can have no guaranteed end-of-lease purchase price.

That is, the owner must assume all the risk of ownership; otherwise the lessee is agreeing a priori to balance out costs by purchase at the end of lease. Moreover, the initial lease cannot run for 100% of an asset's economic life, or the lease will be viewed as a defacto purchase by the IRS. Equipment residual value of 10% to 15% at end of initial lease is generally accepted.

When considering a lease strategy several considerations must be taken into account:

- o An all DoD system does not require a common carrier
- o The FCC does not regulate DoD communications operating in Government frequency bands
- o Absence of FCC regulation allows separation of ownership and operation.

The inference to be drawn from these considerations is that a non-carrier entity can be established for DoD satellite leasing to buffer the satellite builder and the Government. Moreover, this entity need not involve a common carrier, and in fact can be any established organization able to provide satellite systems.

Types of Leases

There are two basic types of leases: an equipment lease, and a service lease.

An equipment lease assumes that the Government leases in-orbit satellites which are under Government control and are used in whatever manner the Government determines. For this type of lease it is assumed that the satellites would be placed in-orbit and checked-out by the lessor prior to being turned over to the Government. The lessor in turn would have to contract for the launch, launch services and Telemetry,

Tracking and Control (TT&C) during the satellite check-out. The costs of such services would be included in the lease rate determination.

A service lease is similar to an equipment lease but additionally it places the entire system operation under the control of the lessor. Since both the ground control stations and the satellites are provided and operated by the lessor, system traffic routing, redundancy shifts, and orbital position shifts must be effected by the lessor at the direction of the Government.

Each of these types of leases can be further divided into two categories of interest to this discussion: a true lease or an installment sale. To qualify as a true lease the IRS criteria mentioned above must be satisfied. The effect of this distinction is to determine which party is the true owner and therefore able to obtain the investment incentives attendant to ownership, including federal income tax reductions. A lease which fails any of the tests noted is deemed an installment sale for tax purposes and the tax incentives are not usable by the lessor (see the discussions on depreciation and investment tax credit).

A service lease can be obtained either from a lessor who owns the satellites or from a lessor who leases the satellites himself. The distinction between these two categories is primarily the method in which the satellites are financed. There should be no difference of service provided to the Government.

System Control

Equipment leasing provides essentially the same rights of control over an asset as does owning it, limited only by obvious exclusions of such acts as destroying it. A service lease, on the other hand, provides for control through the lessor. As its name implies, the user's only

rights are to the service the asset provides, not the asset itself. A spectrum of possibilities exists for limitations and rights of each party in the transaction, and these can be negotiated in each instance.

Existing Government Leases of Communications Satellites

The DoD, AFSCF, and NASA are currently leasing communications services from common carriers for numerous links including contractor operated terminals which will serve both CONUS and overseas networks. These carriers include RCA, AT&T (COMSTAR) and Western Union (Westar) "DOMSATS" for CONUS networks, and INTELSATS for overseas. Some of the terminals are dedicated for Government service and some are shared with other users.

In addition, NASA has contracted with Western Union to provide satellite communications service from TDRSS. Western Union will buy the satellites from TRW. Two military unique leases are being pursued to provide UHF satellite communications service to mobile platforms. These two systems are GAPFILLER and LEASAT. The GAPFILLER satellites were purchased by COMSAT General Corporation, the lessor, from Hughes Aircraft and leased to the U.S. Navy. The LEASAT satellites will be purchased from Hughes Aircraft by a group of lessors. They will lease the satellites to Hughes Communications Service, who will, in turn, lease the communications service to the U.S. Navy. These lease arrangements are discussed further in the Appendixes.

Shared Systems

An important factor in a leased system is whether or not the service or hardware can be shared (either the satellite or the channel capacity) among a mix of military and civilian users. Obviously, if the system is shared some cost sharing and consequent cost reduction to the military should be realized. In two Government satellite leasing examples to date

(GAPFILLER and TDRSS) there was the benefit (potential or actual) of additional users to share costs with the primary Government user. In GAPFILLER/MARISAT sharing of costs between the Navy and maritime users represented a major reduction in price to each user. The Advanced Westar secondary mission on TDRSS permitted Western Union to submit a leased service bid for the primary NASA mission at about 20% less cost than the dedicated system. Under the LEASAT contract the spacecraft are permitted to incorporate additional payloads based upon demonstrated evidence of no adverse schedule or performance impact on the primary Government payload.

Also of prime importance in a shared system are the location and control of the satellite. Priorities have to be established to ensure that the primary Government functions are satisfied by the system.

CONTRACT TYPES

Two Principal Types of Contracts

Basically, there are two types of contracts: fixed-price and cost. The major distinction between the two is in the nature of the seller's obligation. Under a fixed-price contract, the contractor must produce the required items or perform the services for the firm fixed price or within the ceiling price of an incentive contract or he is subject to the penalties provided in a Default clause. There are various types of fixed-price contracts: firm fixed-price (FFP), fixed-price with escalation (FPE), and fixed-price incentive (FPI).

The second general category of contracts is cost reimbursement. Under a cost-type contract, the product is not paid for on the basis of an invoice price; rather the Government pays the contractor's cost of material and labor and a portion of his overhead costs as provided in Cost Principles cited in the contract. Cost-type contracts include cost, cost plus fixed fee (CPFF), and cost plus incentive fee (CPIF).

Under a cost-type contract, the contractor agrees to use his best efforts to complete the contract within the estimated amount provided in the contract but has no obligation for further performance when, despite his best efforts, the contract is not fully performed at the time he expends the funds in the contract, unless the Contracting Officer increases the funds.

Fixed-Price Contracts

Firm Fixed-Price Contract

The firm fixed-price contract, as the name implies, is an agreement by the contractor to furnish designated supplies or services at a specified price which is not subject to adjustment in the light of performance costs. In its basic form, the firm fixed-price contract carries the greatest risk and offers the greatest possibility of profit or loss of any type of contract. The contractor cannot collect more than the agreed fixed price but is entitled to receive the full amount of the fixed price, regardless of his actual performance costs. This type of contract is best suited for procurements where reasonably definite specifications are available, price competition exists, production experience is present, and costs can be predicted with reasonable certainty.

Fixed-Price Contract With Escalation

The fixed-price contract with escalation provides for the upward and downward revision of the proposed price upon the occurrence of certain contingencies which are specifically defined in the contract. The use of this type of contract is appropriate where serious doubt exists as to the stability of the market and labor condition which will exist during an extended period of production, and where contingencies which would otherwise be included in a firm fixed-price contract are identifiable and can be covered separately by escalation.

Fixed-Price Incentive Contract

The fixed-price incentive contract is a fixed-price type contract with provision for adjustment of profit and establishment of the final contract price by a formula based on a relationship which final negotiated total costs bear to total target costs. An incentive contract includes a target cost, a target profit, a price ceiling (but not a profit ceiling or floor), and a formula for establishing final profit and price. After performance of the contract the final price is negotiated and the final contract price is then established in accordance with the formula. Fixed-price incentive contracts are appropriate when, due to the nature of the work required, neither the contractor nor the Government has the confidence to negotiate a firm fixed price, but the contractor is willing to take the risk at the ceiling price established.

Cost-Type Contracts

Cost Contract

The cost contract is a cost-reimbursement-type contract under which the contractor receives no fee. Under this type of contract, the Government agrees to reimburse the contractor for allowable costs of performance as governed by existing regulations and specific terms of the contract. It is used for reseach and development work with educational institutions and other nonprofit institutions, and for facilities contracts.

Cost-Plus-A-Fixed-Fee Contract

The cost-plus-a-fixed-fee contract is a cost-reimbursement-type contract which provides for the payment of a fixed fee to the contractor. In addition, the contractor is reimbursed for the allowable cost of performing the contract as governed by existing regulations and

the terms of the contract. Because the cost-plus-a-fixed-fee contract obligates the Government to reimburse the contractor for the allowable cost of performing the contract without regard to the estimated cost, it specifies a maximum amount beyond which the Government will not be obligated to reimburse the contractor. Irrespective of whether his actual costs are greater or less than the estimated cost, the contractor receives the predetermined fixed fee. If the scope of the contract work is increased or decreased, appropriate increases or decreases both in the estimated cost and the fixed fee are negotiated. The CPFF contract is used (1) for the performance of research, preliminary exploration, or study where the level of effort required is unknown; or (2) where the contract is for development and test and the use of cost-plus-incentive fee is not practical.

Cost-Plus-Incentive Fee Contract

Under this type of contract, the Government and the contractor agree at the time of negotiation of the contract upon the target cost of performance. The target fee is then determined in relation to the target cost. Also established are minimum and maximum fees and, finally, a fee adjustment formula. The incentive-fee contract is used where a cost-reimbursement-type contract is necessary and where there is a probability that its use will result in lower costs to the Government than other forms of cost-reimbursement-type contracts through cost-reduction incentive to the contractor. Maximum fees are subject to the same percentage limitations previously mentioned under cost-plus-a-fixed-fee contracts. The CPIF contract is suitable for use primarily for development and test.

LEASE/BUY COMPARISON

Contractor Competition

In previous competitive cases of communications satellite leasing, the Government had only a few potential lessors in the competition,

namely Western Union and GE in TDRSS, and Comsat, Hughes, and TRW in LEASAT. Other potential lessors in TDRSS refrained from competing, reportedly on the basis the rewards did not match the risk. The net result in these cases was an equivalent restriction in the number of spacecraft suppliers able to enter each lease competition. The situation was similar for GAPFILLER where only a single lessor competed (COMSAT).

In contrast, typically four capable spacecraft suppliers compete in the normal communications satellite buy, where no mating with a potential lessor is required. As recent examples, GE, Hughes, Ford/RCA, and Lockheed competed in DSCS III, and TRW, Hughes, GE, and Rockwell have expressed an interest to bid STRATSAT in a cost-plus buy procurement. This restriction to only a few competing spacecraft suppliers in a lease, compared to four or so capable competitors in a cost-plus buy, may not be in the best interests of either the Government or industry.

Risk

The single most important characteristic differentiating a lease, of whatever type, from the buy of an asset is the comparative apportionment of risk between the parties. This difference affects the lease/buy choice in several important ways: it limits the types of equipment or services that are appropriate to lease, it influences the price, and it has important secondary results such as requiring more precise specifications and reducing requirements for contractor interface.

A lease results in the full burden of successful performance falling upon the provider of the equipment or services, the lessor. The end user, the lessee, makes payments only upon satisfactory performance. Conversely, under the buy alternative significant performance risk is assumed by the buyer.

A satellite project may be a viable candidate for leasing when the technologies involved are sufficiently well developed and the mission

requirements are sufficiently well defined that the risk of failure can be quantified adequately to allow the risk premium to be incorporated into lease rates. If the project involves risks that are unusually great and/or cannot be quantified then the lessor would have to charge a risk premium so great that it would not be economic to enter a lease. Because of the excessive price the contractor might decide not to bid at all. Standard satellite risk with known technology can be insured by the lessor, who then includes those premiums as part of his overall cost. A particular technological uncertainty might be resolved through a pre-procurement cost-reimbursable development contract.

In short, leasing is a viable alternative to buying only when the technology and application are within the technological and operational state-of-the-art for satellite companies. Applications that involve unusual operational environments or significant new technology development are not well suited to lease arrangements.

Budgetary Considerations

A decision to lease or buy a communications satellite system poses some interesting budgetary considerations. The first is the use of the type of funds: Procurement funds for a buy option and O&M funds for a lease option. Under a buy option, procurement funds are required early in the program and are frequently expended years before the asset is placed into service. A lease involves a generally uniform cash flow of O&M funds for lease payments. These payments typically begin concurrent with the initiation of in-orbit service and continue throughout the service period. As such, the timing of a lease/buy decision has a profound impact on the DoD budgeting process with respect to funding in advance. The absence of a firm decision may require the early programming of procurement funds to provide support for a potential buy

option and at the same time considering the trade-off between these funds and the O&M funds needed if the lease option is chosen.

A second important factor is the long-term commitment which is incurred under a lease. Because the lease payments would potentially be required over an extended period, a long-term commitment is being made which impacts future administrations. Since this approach in effect increases the ratio of non-discretionary funds, special legislation by Congress may be required.

Cost Differential

The major factors that directly affect the cost differential between the lease and buy options include the cost of capital, deferred taxes, investment tax credits, and insurance.

Cost of Capital

Many companies cannot generate enough funds internally to meet their total capital requirements. These companies must then get funds from outside the business. A primary means to obtain the required capital is for the firm to borrow from an appropriate lending institution. When borrowing, the firm naturally incurs the cost of using these funds as determined by the applicable interest rate. The applicable interest rate is a function of the financing arrangements as discussed under "Capital Financing" below.

Deferred Taxes

Depreciation of a satellite by the company that owns it provides a significant write-off of income for tax purposes. Under a true lease,

the lessor has this advantage. In addition, federal tax regulations permit the use of depreciation methods for tax purposes which allow greater amounts of depreciation expense in the early years of the life of an asset than in the later years. This method is known as accelerated tax depreciation. Because of it, tax payments are less in the early years and more in later years than they would be if straight-line depreciation were used for both book and tax purposes. This means that some of the taxes shown on the income statement are not currently due but have been deferred to a later time. The company has the use of those funds until they are needed to offset increased taxes in the future due to reductions in depreciation.

Investment Tax Credit

Because the Government tries to encourage the investment of money in capital goods, it provides tax incentives to taxpayers who do this. The major incentive is known as an investment tax credit. Unlike accelerated depreciation, which is a deferral of taxes, an investment tax credit is an actual reduction.

The lessor qualifies for investment tax credit and depreciation incentives under a service lease and a true equipment lease, but not under an equipment lease construed as an installment sale. Thus a service lease or a true equipment lease will qualify the lessor for these savings which can result in a significant reduction in lease rate. In general, the better the case that the asset is vested with the lessor, i.e., the contract satisfies the IRS criteria for a true lease, the more likely the project is to qualify for investment tax incentives.

Insurance

Typically, a lessor of satellite communication capability would go to Lloyds of London to insure against certain types of failures. This

insurance cost would ultimately be passed on to the user in the form of rate charges. Two types of failure are of concern here: failure of the launch vehicle, and failure of the satellites to operate properly in-orbit.

With the use of the Shuttle, the basic STS launch services and other items such as IUS services could be provided as GFE. The Government could assume the risk for GFE failures or schedule problems, including the STS. The contractor could then receive full reimbursement of lost in-orbit performance payments for a GFE failure (on a single satellite basis) and at some negotiated rate for a GFE schedule slip. This approach could result in the lowest lease rate.

Insurance against operational performance loss is available and premiums are related to the length of the lease period. The costs of such coverage must be weighed against the number of systems priced into the lease as backups necessary to assure continuous economical service. Costs for insurance are typically 15-20% of the insured asset.

Commercial vs. Government Procurement Costs

There are some feelings that the direct procurement of satellites by the Government is more expensive than the procurement of satellites with equivalent in-orbit performance by a commercial company under a commercial contract. Factors influencing this view include: more unique Government specifications and testing for procurement, more Government reviews and approvals under a procurement, and the greater flexibility afforded the contractor under a commercial contract. These factors are generally subjective and produce cost impacts that are dependent on the specifics of a given acquisition project.

Performance Incentives

Under a buy strategy the DoD has typically been dedicating approximately 10-15% of the cost to in-orbit performance, while the

commercial organizations have typically been dedicating up to 30% to in-orbit performance. Under a lease strategy the total payment is in the form of in-orbit performance incentives since 100% of payments to the lessor are predicated upon satisfactory service being provided.

Capital Financing

In order to secure capital financing a lessor has to consider several business constraints including:

- o The venture must be financially explainable to the lending associations so that funds can be raised.
- o Financial risks must be clearly identifiable as to:
  - Termination liability
  - Demonstrated technology
  - Launch insurability
  - Performance insurability
- o Low risk of losing money.

There will be a practical limitation to the amount of capital investment the commercial market is willing or able to undertake or the limit of underwriting that a financial institution may feel it wise to provide. If it is still required to obtain that service, it will be necessary for the Government to underwrite a portion of the financial risk involved in obtaining that required service and the Government will have to take measures to assure that service is obtained. This assurance may take the form of monitoring contractor performance, participating in design reviews and/or conducting assessments of the contractors management practices.

Three alternatives to financing are considered:

Federal Financing Bank (FFB)

The FFB is authorized to make commitments to purchase and sell on terms and conditions, determined by the FFB, any obligation which is issued, sold, or guaranteed by a Federal Agency that is authorized to issue, sell, or guarantee the subject obligation. This means that the FFB could loan money to a contractor if the DoD unconditionally guarantees repayment of the loan. This method provides the lowest interest rate to the lessor, and therefore the lowest lease costs to the Government. The DoD must, however, unequivocally guarantee the loan and assume the risk of repayment of the loan if the lessor should default for any reason.

Commercial Bank Financing

This is traditional financing through banks.

Equity Financing

This is the use by a corporation of its own resources. This is commonly the way aerospace companies finance their capital. But, because of pressures by stockholders for reasonable before-tax return on investment of company equity, this can be the least attractive of all the options. Reasonable returns on company equity are frequently higher than ordinary interest.

Overall Cost

It is axiomatic that the lowest overall cost to the Government will result from the acquisition method that produces the fewest expenses.

Consider a hypothetical case in which "Company A" is the only company that can build a particular satellite that the Government needs. Under a Buy option, the Government would contract directly with Company A to build and provide the satellite for use by the Government. Under a lease option, Company B would buy the satellite from Company A, and then lease it (or just the service) to the Government. From this arrangement it would appear obvious that the buy option has the fewest expenses involved and would therefore always be the lowest overall cost option. All things being equal, Company B would have to finance the purchase of the satellite from Company A. Since the cost of financing would constitute an extra expense under the lease option, it would follow that the leased option would be more expensive than the buy option in every case. In general, this statement is true particularly since lessor profit and overhead are added to the lease charges. However, when the time-value of money is considered under each option, i.e., the "present value" of each option is compared, the cost differential can become very small.

It is also true that seldom are "all things equal," as it was assumed in the above example, and many factors can make the actual cost differential vary greatly. Where risk is minimal and routine, and therefore an insignificant part of the cost package, the use of various tax breaks available to a commercial company acting as a lessor (in a true lease situation) can greatly reduce overall expenses to the company. If risk is not minimal, the real and perceived expenses that a lessor would have to cover could increase the overall cost of the lease option, and it could be expected that many companies would not even choose to make an offer.

Another factor that can lower the cost to the Government under a lease is the residual value of the satellite asset at the end of the lease period. If the lessor is willing to accept the risks involved, he might offer a lease rate based on a break-even income during the initial period, with the expectation of making a profit on the residual value.

In other cases, however, the total overall cost to the Government would be expected to be higher under a lease option than under a buy option.

As an added factor, the investment required to develop a lease system is a substantial percentage of the net assets of many prospective lessors. This may alter the overall risk structure of the firm as a whole, thereby reducing the rating of corporate bonds. The net result is that leasing of military communications satellites systems may be too big a financial undertaking and not attractive for many of the spacecraft suppliers.

Cost Comparisons

Unfortunately, there has not been a case where both lease and buy offers were officially solicited from different sources and an actual acquisition decision made on the basis of an economic comparison. In the lease/buy analyses made to date, the method of determining the lower cost acquisition procedure involves the use of a situation similar to the hypothetical case used above. The Government cost is first estimated and then it is assumed that a lessor would have to pay essentially the same price (or perhaps a percentage of the Government price) for the same products. Paper comparisons are then made and the result typically comes out in favor of the buy option. Parametric analyses, however, show that exceptions to this can occur under unique conditions.

In the case of GAPFILLER, leasing was used as an expediency whereby the required minimal capability could be acquired in the shortest possible time using off-the-shelf technology. No lease/buy cost analysis was performed. In the LEASAT situation, leasing was the only alternative provided by Congressional decree. There was, however, a lease/buy cost analysis performed which indicated that the lease option would cost more than the buy option. However, the actual lease bid was lower than either estimate. TDRSS was a case where the lease option was the indicated

preference of GAO. NASA conducted a cost analysis which showed that the buy option would be the least costly but that the discounted costs indicated no clear-cut decision. As such, leasing of TDRSS was considered an acceptable alternative to buying.

There is, however, an ongoing effort to satisfy the NATO communications satellite needs in the 1983 to 1987 time period which does consider bids for both buy and lease options. Cost estimates have been generated for two alternative ways of satisfying this need under a buy option: (1) the use of two DSCS II satellites, and (2) the use of two NATO III satellites. NATO would buy either the DSCS II satellites from TRW or the NATO III satellites from Ford Aerospace. Under a lease option Comsat General would buy the satellites (the same as NATO in the buy option) and then lease the service to NATO. The lease options are for five years of service. Table I summarizes the Air Force Space Division's estimates of the buy option and Comsat's estimates for the lease option. As postulated above, the lease estimates are considerably higher than the buy estimates.

TABLE I
COST ESTIMATES FOR NATO COMMUNICATIONS SATELLITES

	Buy (2 satellites)	Lease (5 year service)
DSCS II	$129.4M	$214.0M
NATO III	$110.4M	$185.6M

Other Comparisons

There are technical, management, and fiscal aspects involved in the acquisition process which differ between the lease and buy strategies. The following discussion presents some of these salient features.

Technical

Since a lease typically would state satellite specifications in terms of performance rather than design, the contractor might be able to realize significant savings in optimizing design and construction without detailed justifications to a Government program review office as would be required on a purchase contract with design specifications.

A lease strategy requires that the design be frozen at the time of contract award. The absence of design changes results in a smoother running program with less chance for delays. On the other hand, freezing the design prohibits the Government from changing the system to meet any changes in requirements. (It must be noted that the lease contract can be modified with an attendent cost growth.)

Management

A lease can offer a possible reduction in management effort required by DoD personnel. If it were desired to enter into a lease arrangement for service, ideally, there should be little or no management of the effort by the DoD. For instance, the DoD should not be especially concerned with hardware configuration, but would be interested primarily in service availability. There is some risk associated with placing the service in being and the risk and consequences of lessor failure to deliver cannot be avoided by DoD. It is assumed under a lease strategy that the lessor assumes all of the financial risk. Much of the management attention today in direct procurements is to insure that the requirement is met. It can be inferred from this argument that while a lease strategy is a motivating force to the lessor to provide the

necessary service, the DoD has traded management control for financial motivation in selecting leasing as a method of doing business.

Fiscal

In general, fiscal constraints under a lease strategy are less of a problem than under a buy strategy. When DoD buys hardware, procurement funds are used, and the total acquisition is often subdivided into several increments. This practice spreads the funding over several years, and tends to keep the yearly expenditures lower. But a yearly budget battle is required and the usual result is a higher overall cost because of steady inflation and the inability of a contractor to realize a benefit from any possible economy of scale. On the other hand, O&M funds are used under a lease strategy. The lessor can generally specify the total program extent and guarantee the availability of funds to a commercial vendor over the life of the program because the lessor can include any potential financial risk in his lease rate schedule and a termination liability in his contract with the Government. This situation could make it possible for a commercial company to buy a satellite system at less cost than the Government. It is considered unlikely, however, that such an acquisition would make it possible for a lease option to cost less than a buy option.

ACQUISITION ALTERNATIVES

Several acquisition alternatives can be developed around the normal evolutionary growth of a system from its R&D phase through the mature operational phase. Four phases are identified here for discussion: research and development, initial operation, improvement and augmentation of an existing system, and replacement and routine operation. The type of contract appropriate for each phase is a function of the technological risks involved.

The research and development phase could include anything from a purchase of advanced technology that ultimately might be applicable to satellite communication to the acquisition of an experimental satellite program. Nevertheless, the acquisitions within this phase will have one feature in common: they all will be intended to demonstrate the feasibility, whether it be technical or operational, of a particular satellite design. As such, it is difficult to write a firm work statement. Certainly writing a work statement for "service" is out of the question. Even writing a work statement for specific hardware is difficult. In truth, what one wants to buy during this phase is the talents of a qualified group organized toward a particular objective. As such, a cost-plus-fixed-fee type of contract is most appropriate, or alternatively, a fixed-price contract for engineering services with a software product specified.

As one proceeds into the initial operational phase it is possible to specify exactly what is to be built. Presumably, the most important results of the R&D phase will be the ability to specify the hardware that's required for an initial operating capability. One now can specify hardware, but since one is barely out of the research and development phase, it is still difficult to be certain about the final performance. The natural kind of contract is for hardware but still on some kind of cost-plus contracting basis. Depending on the technology development required and the associated risks, one has the option of a cost-plus-fixed-fee or a cost-plus-incentive-fee type of contract.

An interesting change takes place as a program matures into the third phase where one is now buying satellites to improve and augment the system. At this point one is tempted to work at specifying performance rather than hardware. By now everyone, both the using agencies and the contractor, has enough experience to consider specifying the performance that is desired and to contract for it on a fixed-price. Normally, the

manufacturers by now have their methods under good control and have learned enough to make the product profitable.

Phase four represents the replacement of failed satellites and the acquisition of satellites for routine operation of the system. At this point, there's no question but that the contract should be of the tightest possible kind, fixed-price, with strong incentives for delivery and performance. This is also the point in the progression where one could at least consider the acquisition not of hardware but the acquisition of the service itself because the system has matured to where it is providing a service. The desirability of this is largely an economic and financial question rather than a fundamental question of acquisition method.

In view of the above discussion it is concluded that a satellite project may be a viable candidate for leasing when the technologies involved are sufficiently well developed that (a) a firm-fixed-price contract is appropriate and (b) the risk of failure can be quantified adequately to allow that risk premium to be incorporated into lease rates. If the project involves technological risks that mandate cost-reimbursable rather than fixed-price contracting, then the lessor would have to charge a risk premium so great that it would not be economic to enter a lease. It is possible, however, to structure non-traditional leasing schemes such as those discussed under "Acquisition Strategy for STRATSAT" which distribute the technological risk between the lessor and the Government.

RISK DURING ACQUISITION

When discussing technological risk in the context of development associated with the acquisition of an operational capability, one must distinguish between the developing of the state-of-the-art of a technology and the capability for assembly-line production of systems

which incorporate that technology. Typically, the laboratory development of a technology is concerned with demonstrating that the appropriate engineering expertise and technological sophistication are at hand to provide a certain capability. The components are produced one-at-a-time and integrated into a "bread board" system which would usually have a capability short of any desired for operational deployment. The cost of such a development is usually quite high. An advanced stage of this technology development is the demonstration on an experimental satellite. This stage requires added sophistication to provide space-qualified components. Because of cost, such demonstrations are kept small with the purpose of demonstrating a capability rather than providing a fully operational service.

The technological risks being considered during the acquisition process are of a slightly different nature. A significant step is taken when one attempts to incorporate the new technologies into operational systems. The first hurdle is the transfer of technology from the laboratory community to the hardware production community. Even if a smooth technology transfer is made, major complications may arise when the technologies are cascaded to produce a system which has enough capability to be a viable operational system. It is assumed that the acquisition process will be started after the required state-of-the-art has been developed, but perhaps with additional development needed to achieve a production capability.

There are several examples of technology development within DoD satellite systems to support this view. The first case in point is the Multiple Beam Antenna (MBA) developed for the LES-7 satellite and later incorporated into the DSCS-III spacecraft design. Lincoln Laboratory developed a 19-element MBA with the intent of flying it on LES-7. The technology was demonstrated in the Laboratory and later accepted as an integral part of the DSCS-III system in the form of two 19-element

transmit and one 61-element receive arrays. The additional development required to incorporate this state-of-the-art technology into DSCS-III has been accomplished as part of the acquisition process, but at some additional expense.

Another case in point is the intermodulation problems which were encountered in the FLTSAT program. Individual channels had been developed and proven in the laboratory but when the 23 channels were combined in an operational system, intermodulation products were produced which caused serious degradations in adjacent channels. These problems resulted in a program delay of several years with the concomitant cost over-runs, even though all of the technology involved was within the then current state-of-the-art.

In the case of STRATSAT, two advanced technologies will be incorporated: large-scale multi-channel on-board processing and EHF crosslinking. In addition, it will be the first MILSATCOM system to use the EHF frequency band. Although these technologies have been developed in the laboratory and even demonstrated on LES-8/9, past experience indicates that there is still considerable risk involved in incorporating all of these technologies into a single operational satellite system.

It is the existence of these "unknowns" which determine whether a system is a viable candidate for leasing. The quality of concern is the maturity of the design and technology. When R&D efforts have a significant risk associated with the development and use of sophisticated new equipment using state-of-the-art technologies, cost-plus-fixed-fee or cost-plus-incentive-fee are the more appropriate contractual arrangements. In this way, those costs resulting from unforeseen problems are borne by the Government.

A comparison of existing systems bears out the potential for excess costs for complex systems. Table II-A shows an overview of communications satellite systems indicating the relative complexity of new technology incorporated, and the related excess costs. Table II-B is a summary of the new high technology areas for those systems with the higher complexity. An immediate observation is that all high technology programs have either experienced cost over-runs or are highly likely to.

CONCLUSION

A lease acquisition strategy is appropriate when:

o Risk is not a factor, or is definable to the extent that it can be quantified in financial terms and included in the lease rate schedule, -and-

o End item design and production/manufacturing methods are established to the extent that firm-fixed-price contracting would be possible.

An actual decision to lease is appropriate when both of the above conditions are met and the overall program cost to the Government is lower than it would be under a buy strategy (cost comparisons are made using OMB Circulars A-76 and A-94 as implemented by DoD Instructions 4100.33 and 7041.33). Since extra costs are normally incurred by a lessor for insurance and financing, other costs must be kept to an absolute minimum. This fact indicates that the project must qualify under IRS rules as a true lease to allow use of the depreciation and investment tax credit incentives. Alternatively, a lease decision would be appropriate if it is desired to spread the cost of a system over the life of the system rather than paying for it all at the beginning of the program, regardless of the overall program cost.

Under all other situations a lease acquisition strategy is probably not feasible.

TABLE II-A
OVERVIEW OF PERTINENT SATELLITE COMPLEXITY

SYSTEM	PARTS* COUNT	NEW TECHNOLOGY COMPLEXITY SMALL SOME MUCH GREAT 0 2 4 6 8 10	EXCESS OF* COST OVER BASIC CONTRACT PRICES
MILITARY/GOV			
MARISAT(HAC)	15,000	X	SMALL 0%
LEASAT(HAC)	-	X	SMALL ?
DSCS II(TRW)	35,000	X	MUCH 23%
FLEETSAT(TRW)	59,000	X	GREAT > 100%
DSCS III(GE)	100,000	X	GREAT > 26%
STRATSAT(?)	-	X	?
TDRSS(TRW)	-	X	GREAT > 80%
INTELSAT			
I/II(HAC)	-/6,000	X	SMALL 4-6%
III(TRW)	10,000	X	SOME 11%
IV(HAC)	22,000	X	SMALL 7%
IVA(HAC)	23,000	X	SOME 10%
V(FORD)	-	X	SOME ?
DOMSAT			
WESTAR(HAC)	-	X	SMALL ?
SATCOM(RCA)	-	X	SMALL 3%
INSAT(FORD)	-	X	SOME ?
SBS/ANIK(HAC)	-	X	? ?

* Excess of costs over basic contract prices and parts count based upon GAO Report LCD-79-108, "Relative Performance of Defense and Commercial Communications Satellite Programs," August 10, 1979.

TABLE II-B
SUMMARY OF NEW HIGH TECHNOLOGY AREAS

FLEETSAT
- o Nuclear Hardening
- o On-Board Signal Processing
- o Multiple UHF Channels

DSCS III
- o Nuclear Hardening
- o Command System
- o Communications Anti-Jam
- o Directable Spot Beams (MBA)
- o Automatic Test Equipment

STRATSAT
- o Multi-Channel Signal Processing
- o EHF Crosslinks
- o EHF Transponders

TDRSS
- o K-Band Transponders
- o Spacecraft-Satellite Crosslinks
- o Advanced Antennas

INTELSAT V
- o Directable Spot Beams
- o Multiple Frequency Bands

ACQUISITION STRATEGY FOR STRATSAT

CANDIDATE STRATEGIES

Four potential candidate acquisition strategies have been developed to provide the required satellite communications capability for STRATSAT:

1. Buy Strategy
2. Lease Strategy
3. Hybrid Lease-Funded Validation Phase
4. Hybrid Lease-Funded Development Phase

The two hybrid lease strategies retain some of the Government/contractor technical management relationship of a "pure" lease, but would provide some initial funding of the contractor to ease the financial burden of a "pure" lease thereby making these strategies more amenable to a prospective contractor.

Buy Strategy

Under the buy strategy, STRATSAT would be acquired in three phases: Validation, Full-Scale Development, and Production. The objectives of each of these phases are as follows.

Validation Phase:

- o Complete preliminary design of the STRATSAT and ancillary equipment.
- o Insure that the STRATSAT is compatible with the SSS user terminal segment, Government launch vehicle, and orbital control elements.

Full-Scale Development Phase:

o Build one developmental satellite and ancillary equipment that will meet Government requirements prior to a production decision.

o Verify through tests that the STRATSAT is compatible with the SSS User Terminal Segment, Air Force Satellite Control Facility (AFSCF) orbital control elements, and Space Transportation System (STS), including Orbiter and launch base.

Production Phase:

o Build and place operational STRATSATs in-orbit and conduct in-orbit test and evaluation of these satellites.

o Provide engineering support and the software necessary for the orbital control of the STRATSAT.

The Validation phase would be awarded to two contractors selected for dual development. This phase will include satellite design and breadboard/brassboarding of critical satellite components. The Full-Scale Development phase effort would be issued to the successful Validation phase contractor. The Production phase would be the acquisition of five production flight vehicles, launch support, and in-orbit support.

Lease Strategy

It should be pointed out that this strategy was developed by the Air Force jointly with all the interested aerospace firms as a reasonable approach to performing the mission under a lease acquisition. Numerous concessions were made to ease the lessor financial liabilities which were not made by the Government in the LEASAT program.. The Government

accepted the burden to solve interface problems in the SSS terminals and limited its flexibility to adjust the satellite requirement to changes in requirements or threat. The Government also accepted the risk for delays in the launch vehicle, the Space Shuttle. In summary, Space Division made a conscientious effort to establish an acceptable lease situation for industry.

The lease strategy assumes that the same in-orbit capabilities will be provided as under the buy strategy. Service would be defined as having these capabilities from at least three satellites plus an orbiting spare in the specified orbit. Lease extensions would be negotiated as required during the initial lease period; however, such extensions would not be guaranteed by the Government during the initial development.

Funding

No Government funding will be provided prior to the initial availability of in-orbit service. The Government will fund the negotiated charges in future year operations and maintenance (O&M) budget lines. Funds for GFE will be budgeted in the appropriate year and category. No Government loan guarantees or progress payments should be assumed for these services.

Service charges would be paid according to actual channel performance parameters. Reimbursement for in-orbit services would be on a channel-by-channel, day-by-day basis where full payment is for global coverage with all channels working. The contractor would also receive payment for lesser constellations, such as coverage loss due to in-orbit failure, but the reimbursement rate per channel would decrease sharply if the minimum constellation requirement threshold is breached over significant coverage areas.

A maximum contractor liability, in case of complete loss of in-orbit service due to premature failures, is a negotiable item.

GFE

The basic STS launch services and the COMSEC/TRANSEC devices would be provided as GFE. Other items such as IUS services or specific hardware items could also be provided. Amount of GFE and total number of STS launches required to provide the service would be negotiated along with the in-orbit service charges and included in the determination of total cost to the Government. Facilities of the AFSCF and selected SSS command posts could also be available. The Government will assume the risk for GFE failures or schedule problems, including the STS. The contractor would receive full reimbursement of lost in-orbit performance payments for a GFE failure (on a single satellite basis) and at some negotiated rate for a GFE schedule slip. Backup launch capability to the STS is not required.

System Control

The contractor would control the satellite from the time it left the Shuttle, through ascent deployment of extendables, and into orbit adjustment. In addition, the contractor would provide maintenance (redundant unit switching) during the satellite lifetime. The contractor could provide his own facilities, or share Government facilities to perform this task.

Interfaces

The contractor would deal directly with NASA to define the STS interfaces, and to perform the special analyses and interface tests to meet STS compatibility requirements. The contractor would reimburse NASA directly for first-time integration charges at DoD rates. The Government would fund recurring launch charges as GFE. The contractor would deal with AFSD to define the SSS terminals and AFSCF interfaces. A schedule

and amount of contractor support required for compatibility tests between the satellites, SSS terminals, and AFSCF would be laid out in the interface agreements. The Government would fund all modifications or test support by the SSS terminal contractors or AFSCF facilities.

Hybrid Lease-Funded Validation Phase

Two contractors would be supported by Government funding to produce a preliminary design prior to defining the services and interface agreements. The time and funds available to perform this work would be similar to the Validation phase under the baseline buy strategy. The winning contractor would enter into a contract with the Government for the services following this phase. Subsequent development and production would be identical to the leased concept, both in funding and management.

Hybrid Lease-Funded Development Phase

Under this concept the two contractors would be funded for a Validation phase similar to that above. At the end of the Validation phase each would propose a services agreement for in-orbit communication plus a proposal for a Government funded Development phase. The Development phase could vary between contractors - one might feel a ground qualification satellite is sufficient, another may feel a prototype launch is required. Degree of risk assumption (i.e., minimizing Government funded development) would be a factor in determining the winner. At some point Government funding would cease and the contractor would provide financing for the production satellites. The further into development that Government funding is required, the fewer "advantages" of a lease arrangement are practical. As the Government assumes more up-front funding, the more technical direction and budget fluctuations are likely to be imposed on the contractor.

The funding approaches for these acquisition strategies are summarized in Table III.

TABLE III
FUNDING FOR CANDIDATE ACQUISITION STRATEGIES

ACQUISITION STRATEGY	VALIDATION PHASE	FULL-SCALE DEVELOPMENT PHASE*	PRODUCTION PHASE
Buy	Dual Contract	Single Contract	Single Contract
Lease	No Payment	No Payment	Lease
Hybrid #1	Dual Contract	No Payment	Lease
Hybrid #2	Dual Contract	Single Contract	Lease

* Current Air Force funding is based upon a Development phase involving a single contract. The Air Force is also considering dual contracts for this phase.

UNIQUENESS OF STRATSAT

Unique-Dedicated Military Mission

STRATSAT has been defined for a highly unique, dedicated mission requiring a radiation hardened, highly maneuverable spacecraft. The USAF expects to operate the system, in particular the communications payload, on a day-to-day military basis with its own personnel through operational ground stations and/or airborne command posts utilizing the operational TT&C.

Unique Orbit

The STRATSAT mission is characterized by a unique orbit, never used before, as a mission orbit. There is no long term experience, such as with the equatorial geosynchronous orbit, that can be described to the insurance industry. The latter orbit is relatively passive with simple, straightforward stationkeeping. The orbital dynamics of the STRATSAT mission orbit have yet to be analyzed in any substantive detail, but the orbital perturbations due to the moon (and possibly the sun, in certain situations) are constantly varying for each of the satellites in the constellation.

DISCUSSION

Since the STRATSAT system incorporates a high level of new technology, it is unlikely that a "pure" lease would be a viable acquisition alternative. In order to advance the technology and thereby reduce the financial risk, the two hybrid lease strategies provide for Government support. These alternatives remove some of the technical "unknowns" and lay the foundation upon which an amenable lease can be built.

The two most viable strategies are the buy strategy and the hybrid lease-funded Development phase strategy. Each of these provide for Government funded Validation and Development phases. The contracting distinction occurs when the Production phase is reached. At this time the design and technology are well understood and the Production phase can consist either of Government bought and owned satellites or of leased satellite hardware or service. At this point the acquisition decision can be made based upon economic factors alone.

Due to the uniqueness of STRATSAT there are no known commercial services that could be feasibly (or economically) shared with this

system. As a result, the cost savings attendant with a shared leased system would not be realized for STRATSAT.

OBSERVATIONS

Based upon the facts presented above several observations can be made:

- o Systems with a high level of new technology are not amenable to a lease.
- o STRATSAT incorporates a high level of new technology.
- o Therefore, STRATSAT is not a viable system for lease unless the technological unknowns can be removed.
- o Government funding of Validation and Full-Scale Development phases eases the financial burden on a lessor, and makes the system more amenable to a lease acquisition strategy.
- o A lease-vs-buy decision can be made at the Production phase based upon economic factors alone. Proper consideration must, however, be given to the programming of funds (whether O&M or Procurement) in prior budget years to cover for the eventual decision.
- o The uniqueness of STRATSAT would preclude any potential cost savings which would be attendant with a shared leased system.

RECOMMENDATIONS

It is recommended that a lease-vs-buy decision not be made at this time and that the Government fund contracts for the Validation and Full-Scale Development phases. The funding of these first two phases should be provided for with R&D funds starting in FY 1981.

It must be noted, however, that until the final decision is made to lease or buy, advanced funding of the Production phase is not well defined. If a buy strategy is chosen, then Procurement funds should start in FY 1983. However, if a lease strategy is chosen, then O&M funding would not be required until FY 1987 under the present schedules.

COMPARATIVE COST ANALYSIS OF STRATSAT LEASE VS. BUY OPTIONS

INTRODUCTION

A comparative cost analysis has been conducted for the lease and buy options to acquire the satellite communications service of STRATSAT. Four candidate acquisition strategies were analyzed:

1. Buy Strategy
2. Lease Strategy
3. Hybrid Lease-Funded Validation Phase
4. Hybrid Lease-Funded Development Phase

Under the buy strategy, STRATSAT would be acquired in three phases: Validation, Full-Scale Development, and Production. The Validation phase would be awarded to two contractors selected for dual development. The Full-Scale Development phase effort would be issued to the successful Validation phase contractor. The Production phase would be the acquisition of five production flight vehicles, launch support, and in-orbit support.

The lease strategy assumes that the same in-orbit capabilities will be provided as under the buy strategy. Service would be defined as having these capabilities from at least three satellites plus an orbiting spare in the specified orbit. Service charges would be paid according to actual channel performance parameters. Reimbursement for in-orbit services would be on a channel-by-channel, day-by-day basis.

Under the hybrid lease-funded validation strategy, two contractors would be supported by Government funding to produce a preliminary design prior to defining the services and interface agreements. The time and

funds available to perform this work would be similar to the Validation phase under the baseline buy strategy. The winning contractor would enter into a contract with the Government for the services following this phase. Subsequent development and production would be identical to the leased concept, both in funding and management.

Under the hybrid lease-funded development concept, the two contractors would be funded for a Validation phase similar to that above. At the end of the Validation phase each would propose a services agreement for in-orbit communication plus a proposal for a Government funded Development phase. At some point Government funding would cease and the contractor would provide financing for the production satellites.

BASIC PROGRAM DATA

Satellite Service Schedule

Satellite service availability dates are assumed as follows:

1 Satellite (Gov't terminal checkout)	Dec 86
2 Satellite (SSS Initial OPS)	Apr 87
3 or more Satellites (FOC Space Segment)	Oct 87
End of service period	Oct 92

The amount of service provided over the analysis period FY 87-92 is as follows:

FY 87	10%	of Total Service
88	18%	"
89	18%	"
90	18%	"
91	18%	"
92	18%	"
	100%	"

Residual operational life after FY92 represents profit potential for lease extension.

Cost Data

The basic cost data (in Constant FY78 $M) used in this analysis was obtained from AFSD as developed for their buy estimates. In the absence of contractor bids for the lease options, the buy estimates were used as a basis to provide a common basis for comparison. Table IV shows the time phasing and categorization of the basic cost estimates in both constant FY78 and the inflated current year values. This data serves as the input data to the cost analysis model. The RDT&E costs are broken into Validation and Development phases to correspond to the Hybrid Lease options discussed above. The Procurement funds are for five satellites including long lead parts, upper stage, launch and orbital support, and orbital incentives. Shuttle integration and launch costs are GFE for all options. Program office costs are assumed lower for the lease options. FCRC costs are assumed equal for all options.

Income Tax Rates

In an analysis to estimate the total cost to the Government one must consider the return of income taxes. The Federal Income Tax (FIT) recovery rates used in this analysis were derived using the following assumptions:

- 50% of work subcontracted (RDT&E & Procurement)
- 50% of work performed by lessor in-house (launch, etc.)
- Lessor and subcontractor granted a 15% return on investment (ROI)
- 50% profit on ROI after taxes
- 48% federal tax on ROI
- 2% state tax on ROI

TABLE IV
BASIC COST DATA FOR STRATSAT COST COMPARISONS

	FISCAL YEAR								
	81	82	83	84	85	86	87	88-92	Total
(CONSTANT FY78 $M)									
RDT&E									
Validation Phase	8.7	19.5	-	-	-	-	-	-	28.4
Development Phase	-	-	61.4	28.2	16.3	3.3	6.1	-	115.1
Procurement	-	-	3.9	55.1	90.3	79.8	11.4	-	240.5
GFE									
Shuttle Integration	0.7	0.9	3.6	1.6	2.1	2.4	1.0	-	12.3
Shuttle Launch	-	-	-	8.1	36.1	25.9	-	-	70.1
Program Office									
Lease	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	4.5
Buy	1.2	1.2	1.2	1.2	1.2	1.2	1.2	2.5	10.9
FCRC	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	13.0
(CURRENT YEAR $M)									
RDT&E									
Validation Phase	9.1	22.2	-	-	-	-	-	-	31.3
Development Phase	-	-	75.5	37.4	23.2	5.0	9.8	-	150.9
Procurement	-	-	5.2	78.4	137.3	129.0	19.5	-	369.4
GFE									
Shuttle Integration	.7	1.0	4.3	2.1	2.9	3.6	1.6	-	16.2
Shuttle Launch	-	-	-	10.5	50.3	38.6	-	-	99.3
Program Office									
Lease	.5	.6	.6	.6	.7	.7	.8	1.9	6.4
Buy	1.2	1.3	1.4	1.6	1.7	1.8	1.9	4.6	15.5
FCRC	1.7	1.8	2.0	2.1	2.3	2.4	2.6	5.1	19.9

The calculations were made, based upon a per dollar cost to the Government, as shown in Table V. Based on $1, granting a 15% lessor ROI would yield a total cost to the lessor equal to $.870 ($1/1.15). The ROI ($.130) is apportioned as 50% ($.065) profit, 2% ($.003) state tax, and 48% ($.062) FIT. Of the total cost to the lessor 50% ($.435) is performed in-house and 50% ($.435) by subcontractor. The subcontractor costs are in turn taxable in a similar manner. Based on $.435, a 15% subcontractor ROI would yield a total cost to the subcontractor equal to $.379 ($.435/1.15). The ROI ($.056) is apportioned as 50% ($.028) profit, 2% ($.001) state taxes, and 48% ($.027) FIT.

TABLE V
ESTIMATING FIT RECOVERY RATE

Cost to Government		$1.000
Lessor 15% ROI		.130
50% Profit	.065	
2% State tax	.003	
48% FIT	.062	
Total Lessor Cost		.870
50% Lessor in-house work		.435
50% work subcontracted		.435
Subcontractor 15% ROI		.056
50% Profit	.028	
2% State tax	.001	
48% FIT	.027	
Subcontractor Cost to Produce		.379

This analysis shows that each dollar cost contains $.027 + $.062 = $.089 FIT recovery on all subcontracted items (RDT&E & procurement) and $.062 recovery on items unique to the lessor (launch, etc.).

In addition, FCRC costs are taxed at a 2% rate in accordance with DoDI 4100.33. A 42% marginal FIT recovery rate was assumed on elements for which there was no other guidance (e.g. interest and insurance).

Escalation

Escalation considerations take into account future expected price levels (changes due to inflation) as well as the time phasing of actual expenditues. Estimates of price level changes affecting program acquisition costs are based upon price level index and program expenditure rate information provided by ASD(C). The program expenditure rates are used to estimate the rates of outlay so that the estimated program costs will reflect the estimated price escalation over the time period during which the outlay will be expended. Table VI presents the weighted price level indexes, which combine the effects of inflation and program expenditure rates, used in this analysis.

TABLE VI
WEIGHTED PRICE LEVEL INDEXES
(FY 81 BASE)

FY	R&D	Proc	O&M
81	1.049	1.129	1.014
82	1.136	1.224	1.105
83	1.229	1.322	1.194
84	1.325	1.423	1.293
85	1.423	1.521	1.392
86	1.519	1.617	1.489
87	1.610	1.709	1.583
88	1.699	1.802	1.670
89	1.792	1.902	1.762
90	1.891	2.006	1.849
91	1.995	2.117	1.961
92	2.105	2.233	2.096
93	2.221	2.356	2.182
94	2.343	2.486	2.302
95	2.472	2.622	2.429

METHODOLOGY

This comparative analysis follows procedures as set forth in two OMB circulars:

- o OMB Circular A-76, "Policies for Acquiring Commercial or Industrial Products and Services needed by the Government," as implemented by DoD Instruction 4100.33, "Operation of Commercial and Industrial-Type Activities."

- o OMB Circular A-94, "Discount rates to be used in evaluating time distributed costs and benefits," as implemented by DoD Instruction 7041.33, "Economic Analysis and Program Evaluation for Resource Management."

A-76 Methodology

This analysis uses the basic cost data as inputs and generates cost estimates for both a lease and a buy option in the format prescribed by the Cost Comparison Handbook, Supplement No. 1 to OMB Circular No. A-76.

For the A-76 analysis, the primary factors considered are: depreciation, cost of capital, contract administration, insurance, and federal income taxes. Depreciation is considered for the tangible capital assets of the satellite program, i.e., the satellites themselves. The effect of depreciation is to spread the cost of the satellites over their useful service life. The cost of capital on the Government's investment is included to account for the opportunity cost; i.e., if the capital had not been devoted to this performance during this period, it could have been devoted to another use which would have provided other income or avoided interest expense. An opportunity cost rate of 10% is assessed to the Government development, procurement, and launch costs. Contract administration costs account for the costs incurred by the Government in assuring that the contract is faithfully executed by both the Government and the contractor. These costs are determined as 4% of the cost of the product or service provided. Contract administration costs are considered for satellite procurement, RDT&E activities, and lease costs. Insurance costs are taken as 15% of the spacecraft cost for the lease options and 3% for the buy option. (These insurance rates are representative for analysis purposes only. The actual rates would depend upon actual conditions at the time of insurability.) Federal income taxes are considered for all relevant expenses and are used in estimating the total cost to the Government.

Factors unique to the lease options are: investment tax credits and tax advantages associated with depreciation methods. The lessor is granted an investment tax credit equal to 10% of his total investment. For tax purposes the lessor is assumed to use double declining balance depreciation in order to take advantage of the resultant deferred tax payment.

When comparing the total costs of the lease and buy options a "new start" cost margin is added to the buy estimates. This cost margin in effect penalizes the buy alternative cost analysis. A new start refers to any activity not currently being done in-house at a particular facility. A cost margin equal to 10% of the estimated Government personnel-related costs plus 25% of the estimated cost of ownership of the required facilities and equipment must be added to the buy costs. The margin of 10% of estimated personnel costs is consistent with the margin favoring the status quo in studies of existing Government activities. The additional 25% margin of the cost of ownership recognizes the risks inherent in Government investment in facilities and equipment. These factors provide a tangible expression of the basic policy of OMB Circular A-76:

> "A new start may not be approved on the basis of economy unless it will result in savings compared to contract performance at least equal to 10 percent of Government personnel-related costs, plus 25 percent of the cost of ownership of equipment and facilities, for the period of the comparative analysis."

Although the new start cost margin was included in the analysis in accordance with OMB Circular A-76, this factor is questionable at best when applied to a communication satellite. The Air Force investment in the SSS communication terminals remains the same in both a lease or buy acquisition. Neither the existing Air Force Satellite Control Facility's nor the Space Division's physical plant and personnel can be considered new starts. Additional Government personnel at Space Division required

in a buy program tend to be offset by the phase out of personnel involved in the procurement of AFSATCOM portions of FLTSATCOM and the Satellite Data System (SDS) satellites. The only new start in facilities or personnel contemplated under the buy acquisition are at two augmented communication command posts. These new costs must be balanced against the additional costs the lessor (contractor) must incur in a lease acquisition to establish his own satellite control system. Another point to be made is that the STRATSAT equipment (satellites) is not a new start, but is an evolution of the AFSATCOM "shares" of the FLTSATCOM and SDS satellites.

A-94 Methodology

The A-94 analysis considers a buy cost profile which very closely approximates the actual flow of funds. The development, launch, and satellite costs are represented as they would be expended. This is in contrast with the A-76 methodology wherein the satellite costs are depreciated over the service period thereby more closely approximating a lease arrangement.

The A-94 lease estimates consider the actual estimated lease payments as well as the administrative and income tax recovery costs. A-94 considers the cost of capital to the Government via the net present value method. The actual cost comparison is done on the discounted costs rather than the actual time phased dollar expenditures. The discounted costs normalize all expenditures to a common base year (FY 81) thereby factoring out the time value of the money. In this way the A-94 methodology in effect is comparing funds of equivalent buying power.

Note that since the A-76 analysis is based upon undiscounted dollars and the A-94 analysis is based upon discounted dollars, a direct comparison between the results of the two methodologies is not meaningful (i.e., do not compare undiscounted dollars with discounted dollars).

COST ANALYSIS RESULTS

Cost Model

Each of these methodologies were used to create a computerized cost model. The results of the primary analysis presented in this section are based upon the assumption that the commercial costs to acquire satellites are the same as for the Government and that the lessor's return on investment is 15%. (As of the writing of this paper the Prime Interest Rate was just under 20%. This equates to a 21-22% return on investment in the current economic market. This higher rate would make the lease option more costly than at 15% but would not affect the buy estimates.) The A-94 analysis uses the 10% discount rate prescribed by OMB Circular A-94. Variations on these parameters are discussed under "Effects of Changing Parameters."

A-76 Analysis Results

The results of the A-76 cost analysis (in current year $M) are contained in Tables VII-A through VII-C. These tables show the comparison between the buy strategy and each of the lease strategies: pure lease, funded validation phase, and funded development phase. Figure 1 is a comparison of the time phasing of the four acquisition strategy costs and Figure 2 is a comparison of the cumulative costs. Several observations are made concerning this data.

- The adjusted buy estimate includes a new start cost differential of $172M or an equivalent 19% increase over the buy estimate. This factor in effect penalizes the buy alternative by this amount.

TABLE VII-A

A-76 COMPARATIVE COST OF BUY AND LEASE PERFORMANCE OF
STRATEGIC SATELLITE SYSTEM
PURE LEASE
MARCH 1980

	FISCAL YEAR 81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	TOTAL
BUY PERFORMANCE																
1. DIRECT MAT (GFE)	0.7	1.0	4.3	12.5	53.2	42.1	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.4
DIRECT MAT (R&D)	9.1	22.2	75.5	37.4	23.2	5.0	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	182.1
3. DIRECT LABOR (PO)	1.2	1.3	1.4	1.6	1.7	1.8	1.9	0.8	0.9	0.9	1.0	1.0	0.0	0.0	0.0	15.5
CONT ADMIN (PRO)	0.0	0.0	0.2	3.1	5.5	5.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8
CONT ADMIN (R&D)	0.4	0.9	3.0	1.5	0.9	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3
5. DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	36.9	66.5	66.5	66.5	66.5	66.5	0.0	0.0	0.0	369.4
6. OTHER (FCRC)	1.7	1.8	2.0	2.1	2.3	2.4	2.6	0.9	1.0	1.0	1.1	1.1	0.0	0.0	0.0	19.9
9. TOTAL	13.1	27.2	86.4	58.2	86.7	56.7	54.0	68.2	68.3	68.4	68.5	68.6	0.0	0.0	0.0	724.5
LEASE PERFORMANCE																
10. CONTRACT PRICE	0.0	0.0	0.0	0.0	0.0	0.0	150.4	270.7	270.7	270.7	270.7	270.7	0.0	0.0	0.0	1504.0
12. CONT ADMIN (LSE)	0.0	0.0	0.0	0.0	0.0	0.0	6.0	10.8	10.8	10.8	10.8	10.8	0.0	0.0	0.0	60.2
CONT ADMIN (R&D)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13. GFE (LNCH)	0.7	1.0	4.3	12.5	53.2	42.1	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.4
GFE (R&D)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15. OTHER (PO)	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.3	0.4	0.4	0.4	0.4	0.0	0.0	0.0	6.4
OTHER (FCRC)	1.7	1.8	2.0	2.1	2.3	2.4	2.6	0.9	1.0	1.0	1.1	1.1	0.0	0.0	0.0	19.9
17. TOTAL	2.9	3.4	6.9	15.3	56.2	45.3	161.3	282.8	282.8	282.9	283.0	283.1	0.0	0.0	0.0	1705.9
OTHER CONSIDERATIONS																
BUY PERFORMANCE																
18. COST OF CAP (PRO)	0.0	0.0	0.5	8.4	22.1	35.0	33.2	26.6	19.9	13.3	6.6	0.0	0.0	0.0	0.0	165.7
COST OF CAP (GFE)	0.1	0.2	0.6	1.9	7.2	11.4	10.4	8.3	6.2	4.2	2.1	0.0	0.0	0.0	0.0	52.4
COST OF CAP (R&D)	0.9	3.1	10.7	14.4	16.7	17.2	16.4	13.1	9.8	6.6	3.3	0.0	0.0	0.0	0.0	112.3
21. OTHER (TAXES)	1.3	3.5	12.4	21.7	37.3	41.7	28.0	20.2	15.1	10.1	5.1	0.0	0.0	0.0	0.0	196.4
OTHER (INS)	0.0	0.0	0.2	2.4	4.1	3.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1
22. TOTAL	-0.3	-0.2	-0.5	5.3	12.8	25.8	32.6	27.8	20.9	13.9	6.9	-0.0	0.0	0.0	0.0	145.1
LEASE PERFORMANCE																
23. COST OF CAP (GFE)	0.1	0.2	0.6	1.9	7.2	11.4	10.4	8.3	6.2	4.2	2.1	0.0	0.0	0.0	0.0	52.4
COST OF CAP (R&D)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27. FED INCOME TAXES	-0.0	-0.1	-0.1	4.0	11.1	12.1	19.6	51.4	82.0	104.0	103.1	102.2	0.0	0.0	0.0	489.3
30. TOTAL	0.1	0.3	0.7	-2.2	-4.0	-0.7	-9.2	-43.1	-75.8	-99.8	-101.0	-102.2	0.0	0.0	0.0	-436.9
MINIMUM COST DIFFERENTIAL																
31. BUY NEW START	2.8	6.2	20.6	13.3	20.1	12.7	12.7	16.8	16.8	16.8	16.8	16.8	0.0	0.0	0.0	172.5
SUMMARY																
33. ADJUSTED BUY COST	15.6	33 2	106.5	76.8	119.7	95.3	99.2	112.9	106.0	99.1	92.3	85.5	0.0	0.0	0.0	1042.1
34. ADJUSTED LSE COST	3.0	3.7	7.6	13.1	52.2	44.6	152.2	239.6	207.0	183.1	182.0	180.9	0.0	0.0	0.0	1269.0
35. BUY MINUS LSE CST	12.6	29.6	98.9	63.7	67.5	50.7	-52.9	-126.8	-101.0	-84.0	-89.7	-95.4	0.0	0.0	0.0	-226.9

CURRENT YEAR $M: BUY FACTOR = 1.00 RETURN ON INVEST = 0.15

TABLE VII-B

A-76 COMPARATIVE COST OF BUY AND LEASE PERFORMANCE OF
STRATEGIC SATELLITE SYSTEM
FUNDED VALIDATION
MARCH 1980

	FISCAL YEAR															
	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	TOTAL
BUY PERFORMANCE																
1. DIRECT MAT (GPE)	0.7	1.0	4.3	12.5	53.2	42.1	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.4
DIRECT MAT (R&D)	9.1	22.2	75.5	37.4	23.2	5.0	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	182.1
3. DIRECT LABOR (PO)	1.2	1.3	1.4	1.6	1.7	1.8	1.9	0.8	0.9	0.9	1.0	1.0	0.0	0.0	0.0	15.5
CONT ADMIN (PRO)	0.0	0.0	0.2	3.1	5.5	5.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8
CONT ADMIN (R&D)	0.4	0.9	3.0	1.5	0.9	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3
5. DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	36.9	66.5	66.5	66.5	66.5	66.5	0.0	0.0	0.0	369.4
6. OTHER (PCRC)	1.7	1.8	2.0	2.1	2.3	2.4	2.6	0.9	1.0	1.0	1.1	1.1	0.0	0.0	0.0	19.9
9. TOTAL	13.1	27.2	86.4	58.2	86.7	56.7	54.0	68.2	68.3	68.4	68.5	68.6	0.0	0.0	0.0	724.5
LEASE PERFORMANCE																
10. CONTRACT PRICE	0.0	0.0	0.0	0.0	0.0	0.0	137.1	246.7	246.7	246.7	246.7	246.7	0.0	0.0	0.0	1370.5
12. CONT ADMIN (LSE)	0.0	0.0	0.0	0.0	0.0	0.0	5.5	9.9	9.9	9.9	9.9	9.9	0.0	0.0	0.0	54.8
CONT ADMIN (R&D)	0.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
13. GPE (LNCH)	0.7	1.0	4.3	12.5	53.2	42.1	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.4
GPE (R&D)	9.1	22.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.3
15. OTHER (PO)	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.3	0.4	0.4	0.4	0.4	0.0	0.0	0.0	6.4
OTHER (PCRC)	1.7	1.8	2.0	2.1	2.3	2.4	2.6	0.9	1.0	1.0	1.1	1.1	0.0	0.0	0.0	19.9
17. TOTAL	12.4	26.4	6.9	15.3	56.2	45.3	147.5	257.8	257.9	257.9	258.0	258.1	0.0	0.0	0.0	1599.7
OTHER CONSIDERATIONS																
BUY PERFORMANCE																
18. COST OF CAP (PRO)	0.0	0.0	0.5	8.4	22.1	35.0	33.2	26.6	19.9	13.3	6.6	0.0	0.0	0.0	0.0	165.7
COST OF CAP (GPE)	0.1	0.2	0.6	1.9	7.2	11.4	10.4	8.3	6.2	4.2	2.1	0.0	0.0	0.0	0.0	52.4
COST OF CAP (R&D)	0.9	3.1	10.7	14.4	16.7	17.2	16.4	13.1	9.8	6.6	3.3	0.0	0.0	0.0	0.0	112.3
21. OTHER (TAXES)	1.3	3.5	12.4	21.7	37.3	41.7	28.0	20.2	15.1	10.1	5.1	0.0	0.0	0.0	0.0	196.4
OTHER (INS)	0.0	0.0	0.2	2.4	4.1	3.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1
22. TOTAL	-0.3	-0.2	-0.5	5.3	12.8	25.8	32.6	27.8	20.9	13.9	6.9	-0.0	0.0	0.0	0.0	145.1
LEASE PERFORMANCE																
23. COST OF CAP (GPE)	0.1	0.2	0.6	1.9	7.2	11.4	10.4	8.3	6.2	4.2	2.1	0.0	0.0	0.0	0.0	52.4
COST OF CAP (R&D)	0.9	3.1	3.1	3.1	3.1	3.1	2.8	2.3	1.7	1.1	0.6	-0.0	-0.0	-0.0	-0.0	25.0
27. FED INCOME TAXES	0.5	1.4	1.2	5.4	12.4	13.4	17.2	44.9	73.6	94.1	93.0	91.9	0.0	0.0	0.0	449.1
30. TOTAL	0.5	1.9	2.5	-0.4	-2.1	1.1	-4.0	-34.3	-65.7	-88.8	-90.4	-91.9	0.0	0.0	0.0	-371.7
MINIMUM COST DIFFERENTIAL																
31. BUY NEW START	2.8	6.2	20.6	13.3	20.1	12.7	12.7	16.8	16.8	16.8	16.8	16.8	0.0	0.0	0.0	172.5
SUMMARY																
33. ADJUSTED BUY COST	15.6	33.2	106.5	76.8	119.7	95.3	99.2	112.9	106.0	99.1	92.3	85.5	0.0	0.0	0.0	1042.1
34. ADJUSTED LSE COST	12.9	28.3	9.4	14.9	54.0	46.4	143.5	223.5	192.2	169.1	167.6	166.2	0.0	0.0	0.0	1228.0
35. BUY MINUS LSE CST	2.7	5.0	97.1	61.9	65.7	48.9	-44.2	-110.6	-86.2	-69.9	-75.3	-80.7	0.0	0.0	0.0	-185.9

CURRENT YEAR $M: BUY FACTOR = 1.00 RETURN ON INVEST = 0.15

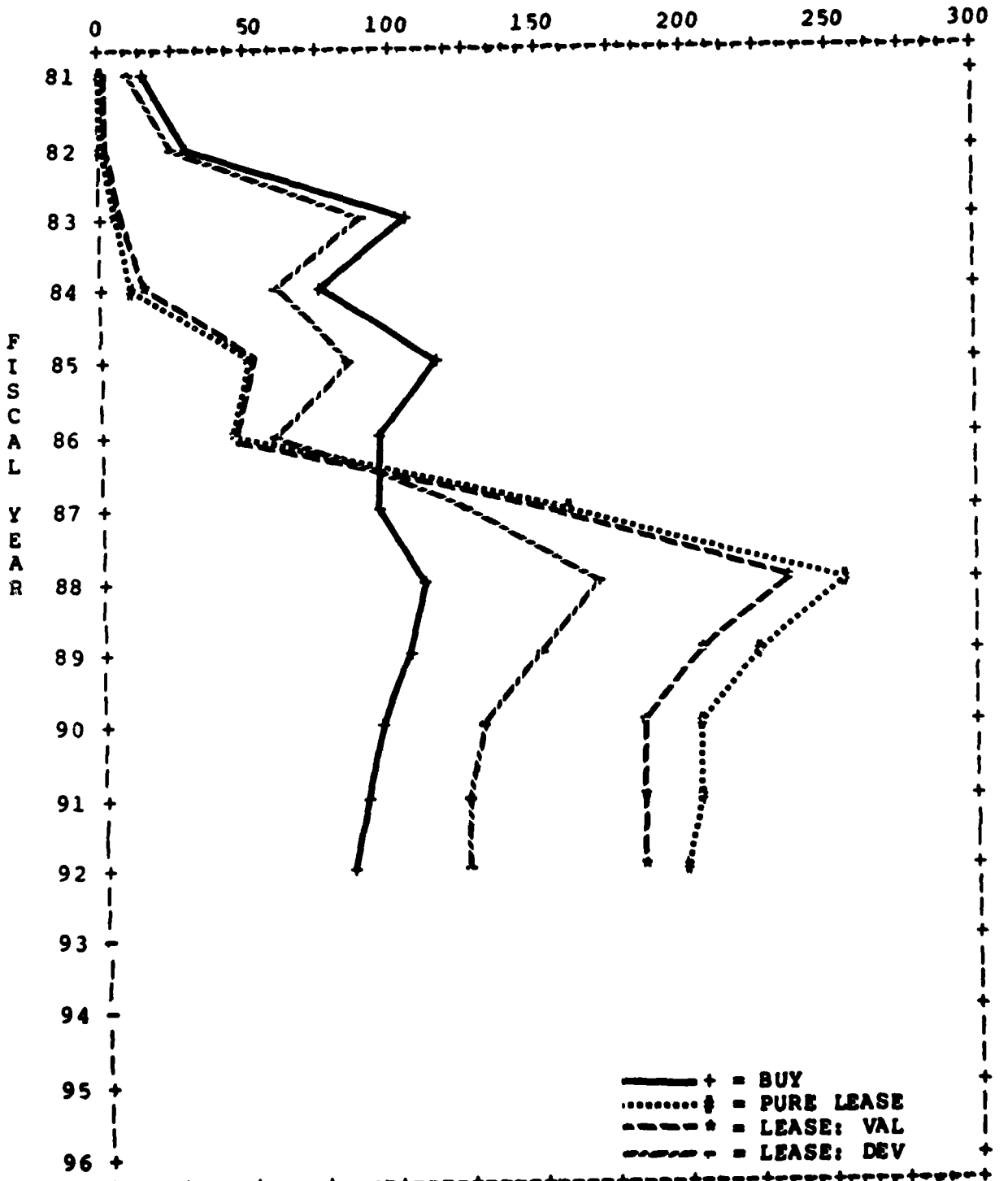
TABLE VII-C

A-76 COMPARATIVE COST OF BUY AND LEASE PERFORMANCE OF
STRATEGIC SATELLITE SYSTEM
FUNDED DEVELOPMENT
MARCH 1980

	FISCAL YEAR															
	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	TOTAL
BUY PERFORMANCE																
1. DIRECT MAT (GFE)	0.7	1.0	4.3	12.5	53.2	42.1	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.4
DIRECT MAT (R&D)	9.1	22.2	75.5	37.4	23.2	5.0	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	182.1
3. DIRECT LABOR (PO)	1.2	1.3	1.4	1.6	1.7	1.8	1.9	0.8	0.9	0.9	1.0	1.0	0.0	0.0	0.0	15.5
CONT ADMIN (PRO)	0.0	0.0	0.2	3.1	5.5	5.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8
CONT ADMIN (R&D)	0.4	0.9	3.0	1.5	0.9	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3
5. DEPRECIATION	0.0	0.0	0.0	0.0	0.0	0.0	36.9	66.5	66.5	66.5	66.5	66.5	0.0	0.0	0.0	369.4
6. OTHER (FCRC)	1.7	1.8	2.0	2.1	2.3	2.4	2.6	0.9	1.0	1.0	1.1	1.1	0.0	0.0	0.0	19.9
9. TOTAL	13.1	27.2	86.4	58.2	86.7	56.7	54.0	68.2	68.3	68.4	68.5	68.6	0.0	0.0	0.0	724.5
LEASE PERFORMANCE																
10. CONTRACT PRICE	0.0	0.0	0.0	0.0	0.0	0.0	93.6	168.5	168.5	168.5	168.5	168.5	0.0	0.0	0.0	935.9
12. CONT ADMIN (LSE)	0.0	0.0	0.0	0.0	0.0	0.0	3.7	6.7	6.7	6.7	6.7	6.7	0.0	0.0	0.0	37.4
CONT ADMIN (R&D)	0.4	0.9	3.0	1.5	0.9	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3
13. GFE (LNCH)	0.7	1.0	4.3	12.5	53.2	42.1	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.4
GFE (R&D)	9.1	22.2	75.5	37.4	23.2	5.0	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	182.1
15. OTHER (PO)	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.3	0.4	0.4	0.4	0.4	0.0	0.0	0.0	6.4
OTHER (FCRC)	1.7	1.8	2.0	2.1	2.3	2.4	2.6	0.9	1.0	1.0	1.1	1.1	0.0	0.0	0.0	19.9
17. TOTAL	12.4	26.4	85.4	54.2	80.3	50.5	112.5	176.4	176.5	176.6	176.7	176.7	0.0	0.0	0.0	1304.6
OTHER CONSIDERATIONS																
BUY PERFORMANCE																
18. COST OF CAP (PRO)	0.0	0.0	0.5	8.4	22.1	35.0	33.2	26.6	19.9	13.3	6.6	0.0	0.0	0.0	0.0	165.7
COST OF CAP (GFE)	0.1	0.2	0.6	1.9	7.2	11.4	10.4	8.3	6.2	4.2	2.1	0.0	0.0	0.0	0.0	52.4
COST OF CAP (R&D)	0.9	3.1	10.7	14.4	16.7	17.2	16.4	13.1	9.8	6.6	3.3	0.0	0.0	0.0	0.0	112.3
21. OTHER (TAXES)	1.3	3.5	12.4	21.7	37.3	41.7	28.0	20.2	15.1	10.1	5.1	0.0	0.0	0.0	0.0	196.4
OTHER (INS)	0.0	0.0	0.2	2.4	4.1	3.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1
22. TOTAL	-0.3	-0.2	-0.5	5.3	12.8	25.8	32.6	27.8	20.9	13.9	6.9	-0.0	0.0	0.0	0.0	145.1
LEASE PERFORMANCE																
23. COST OF CAP (GFE)	0.1	0.2	0.6	1.9	7.2	11.4	10.4	8.3	6.2	4.2	2.1	0.0	0.0	0.0	0.0	52.4
COST OF CAP (R&D)	0.9	3.1	10.7	14.4	16.7	17.2	16.4	13.1	9.8	6.6	3.3	0.0	0.0	0.0	0.0	112.3
27. FED INCOME TAXES	0.5	1.4	5.2	10.5	18.4	19.4	16.4	32.1	51.8	65.5	63.3	61.0	0.0	0.0	0.0	345.5
30. TOTAL	0.5	1.9	6.1	5.8	5.5	9.2	10.4	-10.6	-35.8	-54.8	-57.9	-61.0	0.0	0.0	0.0	-180.8
MINIMUM COST DIFFERENTIAL																
31. BUY NEW START	2.8	6.2	20.6	13.3	20.1	12.7	12.7	16.8	16.8	16.8	16.8	16.8	0.0	0.0	0.0	172.5
SUMMARY																
33. ADJUSTED BUY COST	15.6	33.2	106.5	76.8	119.7	95.3	99.2	112.9	106.0	99.1	92.3	85.5	0.0	0.0	0.0	1042.1
34. ADJUSTED LSE COST	12.9	28.3	91.4	59.9	85.8	59.7	122.9	165.8	140.7	121.8	118.7	115.7	0.0	0.0	0.0	1123.7
35. BUY MINUS LSE CST	2.7	5.0	15.1	16.9	33.9	35.6	-23.7	-52.9	-34.7	-22.6	-26.4	-30.2	0.0	0.0	0.0	-81.6

CURRENT YEAR $M: BUY FACTOR = 1.00 RETURN ON INVEST = 0.15

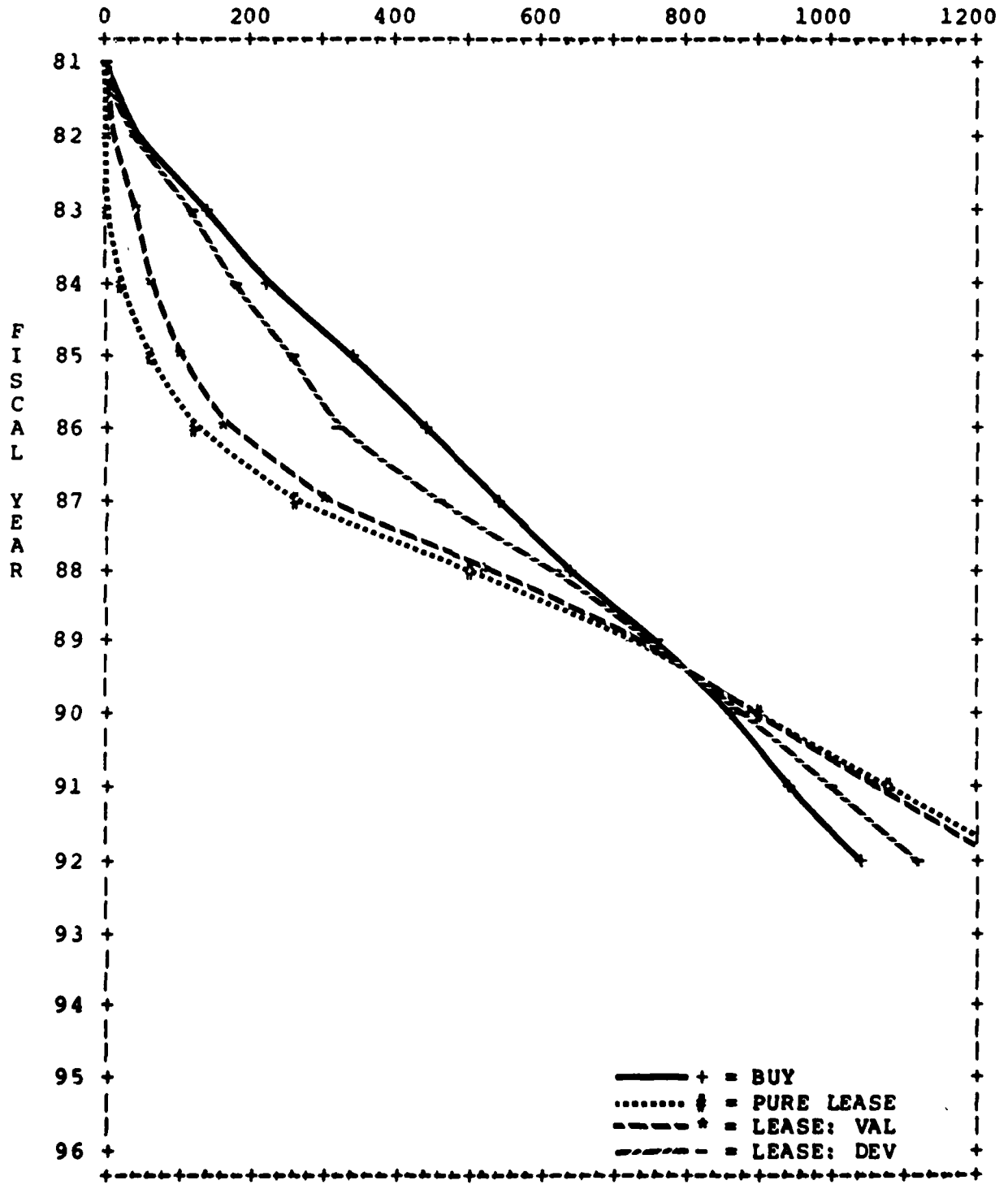
FIGURE 1
A-76 TIME PHASED COSTS
CURRENT YEAR $M



BUY FACTOR = 1.00
RETURN ON INVEST = 0.15

FIGURE 2

A-76 CUMULATIVE COSTS
CURRENT YEAR $M



BUY FACTOR = 1.00
RETURN ON INVEST = 0.15

- The Buy cost profile is relatively uniform over the entire period FY81-92. This is because the development and launch costs are incurred FY81-86 while the satellite production costs are depreciated over the service period FY87-92.

- The Pure Lease profile shows major funding during the service period of FY87-92. The pre-FY87 funding reflects the Government costs to provide the launch vehicles and integration.

- The Funded Validation data is very similar to the Pure Lease data. The slight difference is due to the $31M Validation Phase R&D funds being GFE.

- The Funded Development data represents a relative mean between the Buy and Pure Lease options. This reflects the costs of the GFE development funds pre-FY87 and the lease costs post-FY87.

- The total costs of each of the lease options is larger than the buy costs. Table VIII summarizes the total costs for each option and shows the percent of higher cost for the lease options.

TABLE VIII

A-76 COMPARISON OF TOTAL COSTS
(Current Year $M)
(Return on Investment = 15%)

Adjusted Buy	Pure Lease	Funded Val	Funded Dev
1042	1269 (+22%)	1228 (+18%)	1123 (+7%)

A-94 Analysis Results

The results of the A-94 cost analysis (in current year $M) are contained in Tables IX-A through IX-C. These tables show the comparison between the discounted costs (10% discount rate) for the buy strategy and each of the lease strategies. Figure 3 is a plot of the cumulative discounted costs for a 10% discount rate. Several observations are made concerning this data.

- o The Buy cost profile shows the requirement for full funding early in the program.

- o The comments on the undiscounted alternative lease costs in Tables IX-A through IX-C are the same as for the A-76 discussion.

- o The total discounted differential costs are uniformly lower for the Buy strategy. Table X summarizes the total discounted costs for each acquisition alternative.

- o The cumulative plot of discounted values shown in Figure 3 indicates that the Buy costs saturate in FY87 whereas the lease costs are monotonically increasing over time. In fact, if the lease period were extended beyond the 5 year service period FY87-92 the lease payments would continue thereby causing the cumulative costs to increase after FY92. On the other hand, the major Buy costs have been incurred pre-FY87 and would not result in significantly increased cost for post-FY92 service. (O&M costs would naturally continue throughout the life of the system.)

TABLE IX-A
SUMMARY OF A-94 COSTS FOR
ECONOMIC ANALYSIS/PROGRAM EVALUATION OF
STRATEGIC SATELLITE SYSTEM
PURE LEASE
(CURRENT YEAR $M)

SUBMITTING DOD COMPONENT: DEFENSE COMMUNICATIONS AGENCY
MILSATCOM SYSTEMS OFFICE

DATE OF SUBMISSION: MARCH 1980

PROJECT TITLE: STRATEGIC SATELLITE SYSTEM

DESCRIPTION OF PROJECT OBJECTIVE: TO PROVIDE COMMUNICATIONS FOR THE COMMAND AND CONTROL OF STRATEGIC NUCLEAR FORCES

ALTERNATIVES
A. BUY
B. PURE LEASE

ECONOMIC LIFE
A. 7 YEAR MMD
B. 5 YEAR LEASE

FISCAL YEAR	COSTS			DISCOUNT FACTOR (10.0%)	DISCOUNTED COSTS		
	BUY	LEASE	DIFF		BUY	LEASE	DIFF
81	12.2	3.0	9.3	0.954	11.7	2.8	8.8
82	25.1	3.6	21.6	0.867	21.8	3.1	18.7
83	84.2	7.3	77.0	0.788	66.4	5.7	60.7
84	127.7	12.1	115.6	0.717	91.5	8.6	82.8
85	210.2	48.0	162.2	0.651	136.9	31.3	105.7
86	174.7	38.0	136.7	0.592	103.5	22.5	81.0
87	34.3	146.1	-111.8	0.538	18.5	78.7	-60.2
88	1.7	234.8	-233.1	0.489	0.8	114.9	-114.1
89	1.8	203.4	-201.6	0.445	0.8	90.5	-89.7
90	1.9	180.7	-178.8	0.405	0.8	73.1	-72.3
91	2.0	180.8	-178.8	0.368	0.7	66.5	-65.7
92	2.1	180.9	-178.7	0.334	0.7	60.5	-59.8
93	0.0	0.0	0.0	0.304	0.0	0.0	0.0
94	0.0	0.0	0.0	0.276	0.0	0.0	0.0
95	0.0	0.0	0.0	0.251	0.0	0.0	0.0
TOTALS	678.0	1238.6	-560.6		454.1	558.2	-104.2

BUY FACTOR = 1.00
RETURN ON INVEST = 0.15

TABLE IX-B
SUMMARY OF A-94 COSTS FOR
ECONOMIC ANALYSIS/PROGRAM EVALUATION OF
STRATEGIC SATELLITE SYSTEM
FUNDED VALIDATION
(CURRENT YEAR $M)

SUBMITTING DOD COMPONENT: DEFENSE COMMUNICATIONS AGENCY
MILSATCOM SYSTEMS OFFICE

DATE OF SUBMISSION: MARCH 1980

PROJECT TITLE: STRATEGIC SATELLITE SYSTEM

DESCRIPTION OF PROJECT OBJECTIVE: TO PROVIDE COMMUNICATIONS FOR THE COMMAND AND CONTROL OF STRATEGIC NUCLEAR FORCES

ALTERNATIVES
A. BUY
B. FUNDED VALIDATION

ECONOMIC LIFE
A. 7 YEAR MMD
B. 5 YEAR LEASE

FISCAL YEAR	COSTS			DISCOUNT FACTOR (10.0%)	DISCOUNTED COSTS		
	BUY	LEASE	DIFF		BUY	LEASE	DIFF
81	12.2	12.4	-0.1	0.954	11.7	11.8	-0.1
82	25.1	26.4	-1.2	0.867	21.8	22.9	-1.1
83	84.2	7.3	77.0	0.788	66.4	5.7	60.7
84	127.7	12.1	115.6	0.717	91.5	8.6	82.8
85	210.2	48.0	162.2	0.651	136.9	31.3	105.7
86	174.7	38.0	136.7	0.592	103.5	22.5	81.0
87	34.3	135.8	-101.5	0.538	18.5	73.1	-54.7
88	1.7	217.4	-215.6	0.489	0.8	106.4	-105.5
89	1.8	187.6	-185.8	0.445	0.8	83.5	-82.7
90	1.9	166.0	-164.1	0.405	0.8	67.2	-66.4
91	2.0	166.1	-164.1	0.368	0.7	61.1	-60.3
92	2.1	166.2	-164.1	0.334	0.7	55.6	-54.8
93	0.0	0.0	0.0	0.304	0.0	0.0	0.0
94	0.0	0.0	0.0	0.276	0.0	0.0	0.0
95	0.0	0.0	0.0	0.251	0.0	0.0	0.0
TOTALS	678.0	1183.1	-505.1		454.1	549.6	-95.5

BUY FACTOR = 1.00
RETURN ON INVEST = 0.15

TABLE IX-C
SUMMARY OF A-94 COSTS FOR
ECONOMIC ANALYSIS/PROGRAM EVALUATION OF
STRATEGIC SATELLITE SYSTEM
FUNDED DEVELOPMENT
(CURRENT YEAR $M)

SUBMITTING DOD COMPONENT: DEFENSE COMMUNICATIONS AGENCY
MILSATCOM SYSTEMS OFFICE

DATE OF SUBMISSION: MARCH 1980

PROJECT TITLE: STRATEGIC SATELLITE SYSTEM

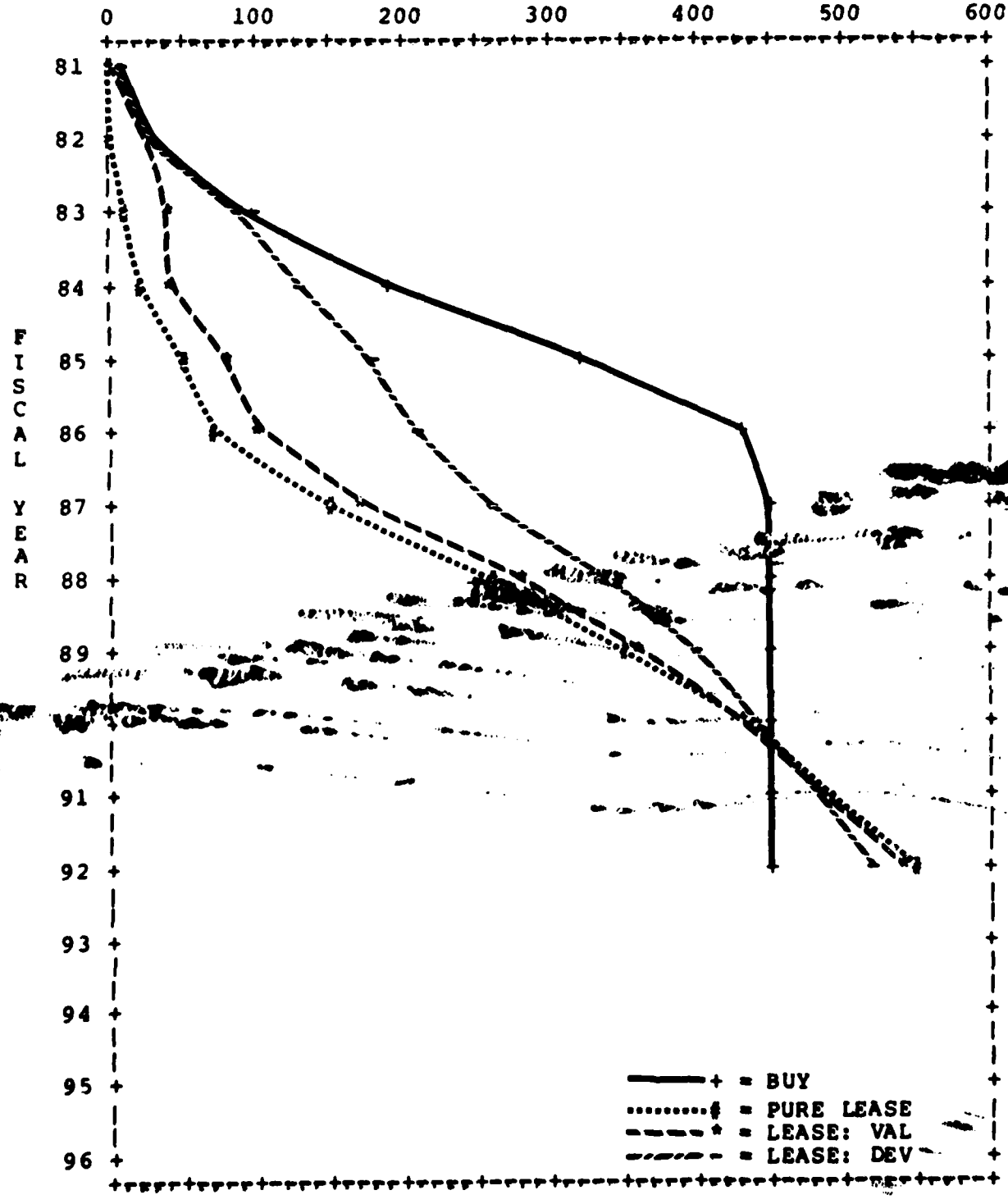
DESCRIPTION OF PROJECT OBJECTIVE: TO PROVIDE COMMUNICATIONS FOR THE COMMAND AND CONTROL OF STRATEGIC NUCLEAR FORCES

ALTERNATIVES	ECONOMIC LIFE
A. BUY	A. 7 YEAR MMD
B. FUNDED DEVELOPMENT	B. 5 YEAR LEASE

FISCAL YEAR	COSTS			DISCOUNT FACTOR (10.0%)	DISCOUNTED COSTS		
	BUY	LEASE	DIFF		BUY	LEASE	DIFF
81	12.2	12.4	-0.1	0.954	11.7	11.8	-0.1
82	25.1	26.4	-1.2	0.867	21.8	22.9	-1.1
83	84.2	84.9	-0.7	0.788	66.4	66.9	-0.5
84	127.7	50.5	77.1	0.717	91.5	36.2	55.3
85	210.2	71.9	138.3	0.651	136.9	46.8	90.1
86	174.7	43.1	131.6	0.592	103.5	25.5	77.9
87	34.3	107.4	-73.1	0.538	18.5	57.8	-39.3
88	1.7	153.4	-151.7	0.489	0.8	75.1	-74.2
89	1.8	131.4	-129.6	0.445	0.8	58.5	-57.7
90	1.9	115.5	-113.6	0.405	0.8	46.7	-46.0
91	2.0	115.6	-113.6	0.368	0.7	42.5	-41.8
92	2.1	115.7	-113.6	0.334	0.7	38.6	-38.0
93	0.0	0.0	0.0	0.304	0.0	0.0	0.0
94	0.0	0.0	0.0	0.276	0.0	0.0	0.0
95	0.0	0.0	0.0	0.251	0.0	0.0	0.0
TOTALS	678.0	1028.2	-350.2		454.1	529.4	-75.4

BUY FACTOR = 1.00
RETURN ON INVEST = 0.15

FIGURE 3
A-94 CUMULATIVE DISCOUNTED COSTS (10.0%)
CURRENT YEAR $M



BUY FACTOR = 1.00
RETURN ON INVEST = 0.15

TABLE X
A-94 COMPARISON OF DISCOUNTED COSTS
(Discount Rate = 10% (FY 81))
(Return on Investment = 15%)

Buy	Pure Lease	Funded Val	Funded Dev
454	558 (+23%)	549 (+21%)	529 (+16%)

Effects of Changing Parameters

In addition to the primary analysis, parametric analyses were conducted to determine the effects of changing some of the more important factors. These included:

- o Commercial costs = 90% of Government costs to procure the satellites and the timing is one year less.
- o Return on Investement of 10%, 15%, and 20%.
- o Discount rates of 7.5%, 10%, and 12.5%.

These parametric analyses show that the overall lease cost is expected to be higher than the buy cost except under unique conditions.

There is a view held by some that a commercial firm can acquire satellites at lower cost and in less time than the Government. In order to show the impact of this view a parametric analysis was conducted with the assumption that commercial costs are 90% that of Government and the timing is one year less. (The 10% decrease in costs of the individual satellites is probably valid, but most contractors would have to build additional spare satellites--six or seven instead of five--to protect their source of revenue.) Table XI shows the difference in these assumptions.

TABLE XI

COMPARISON OF COMMERCIAL VS GOVERNMENT ACQUISITION COSTS
(Current Year $M)

	FISCAL YEAR							
	81	82	83	84	85	86	87	Total
Commercial Costs = 100% Government Costs same schedule								
Development	9.1	22.2	75.5	37.4	23.2	5.0	9.8	182.2
Procurement	-	-	5.2	78.4	137.3	129.0	19.5	369.4
Commercial Costs = 90% Government Costs one year shorter schedule								
Development	8.2	20.0	68.0	33.7	20.9	13.3	-	164.0
Procurement	-	-	-	75.2	123.6	116.1	17.6	332.5

In addition, the costs were estimated for rates of return on investment (ROI) equal to 10%, 15%, and 20% (current prime interest rates of about 18% equate to return on investment of about 20%) and discount rates of 7.5%, 10%, and 12.5%. The results of this analysis are shown in Table XII for A-76 and Tables XIII-A and XIII-B for A-94. The following observations are made:

A-76

- The lease estimates are lower than the buy estimates for a 10% ROI and higher for 15% and 20% ROI even when considering the cost savings to a commercial firm. Note that the buy estimates include the new start differential which imposes a 19% penalty.

- The variation in cost estimates between the three lease options is small (<5%) for the 10% ROI, medium (<15%) for 15% ROI, and large (>20%) for 20% ROI.

- The lease costs for a 20% ROI are from 22% to 45% higher than for a 10% ROI.

- The Funded Development Phase is uniformly the lowest cost option among the three leasing strategies.

A-94

- Discounting has not significantly changed (<2%) the difference in cost of the Pure Lease option over the Buy option as compared with the A-76 results. This difference is somewhat larger for the Funded Validation (<4%) and Funded Development (>9%) options. In each case the change is an increase thereby showing more preference to a buy strategy than did the A-76 results.

- It is interesting to note that a 10% ROI results in the Pure Lease option being preferred over the partially funded options. This is a reversal of the results for the higher values of ROI.

- Changing the discount rate does not change the lease vs. buy preference but does change the % of difference in cost. The lower discount rates show more favor to the buy option.

TABLE XII
SUMMARY OF A-76 PARAMETRIC ANALYSIS
(Current Year $M)

Return on Investment	Buy	Pure Lease	Funded Val	Funded Dev
Commercial Costs = 100% Government Costs same schedule				
10%	1042	1051 (+1%)	1035 (-1%)	1000 (-4%)
15%	1042	1269 (+22%)	1228 (+18%)	1123 (+7%)
20%	1042	1527 (+46%)	1452 (+39%)	1264 (+21%)
Commercial Costs = 90% Government Costs one year shorter schedule				
10%	1042	963 (-8%)	953 (-9%)	941 (-10%)
15%	1042	1158 (+11%)	1126 (+8%)	1051 (+1%)
20%	1042	1391 (+33%)	1328 (+27%)	1177 (+12%)

TABLE XIII-A
SUMMARY OF A-94 PARAMETRIC ANALYSIS
(Discount Rate = 10%)

Return on Investment	Buy	Pure Lease	Funded Val	Funded Dev
Commercial Costs = 100% Government Costs same schedule				
10%	454	466 (+3%)	468 (+3%)	477 (+5%)
15%	454	558 (+23%)	549 (+21%)	529 (+16%)
20%	454	667 (+46%)	644 (+41%)	588 (+29%)
Commercial Costs = 90% Government Costs one year shorter schedule				
10%	454	428 (-6%)	433 (-5%)	452 (-1%)
15%	454	511 (+12%)	506 (+11%)	497 (+9%)
20%	454	609 (+33%)	591 (+30%)	551 (+21%)

TABLE XIII-B
A-94 COMPARISON OF DISCOUNTED COSTS
(Return on Investment = 15%)

Discount Rate	Buy	Pure Lease	Funded Val	Funded Dev
7.5%	501	672 (+34%)	648 (+31%)	617 (+22%)
10.0%	454	558 (+23%)	549 (+21%)	529 (+16%)
12.5%	414	464 (+12%)	462 (+11%)	459 (+10%)

CONTRACTOR RESPONSES TO LEASING OF STRATSAT

INTRODUCTION

In February 1980, Air Force Space Division issued a letter to industry requesting comments concerning the financial impact and practicality of leasing STRATSAT. Responses were received from six communications satellite manufacturers (Ford Aerospace & Communications Corporation, General Electric Company, Hughes Aircraft Company, RCA, Rockwell International, and TRW) and one commercial satellite leasing company (Comsat General Corporation). The following statements are abstracted from these responses.

ABSTRACTS OF RESPONSES

Ford Aerospace & Communications Corporation

"Although we are engaged in the development, production and launch support of spacecraft, leasing satellites has not been part of Ford's business plan. At this time, we have no basis to change this plan and must kindly decline to participate in the STRATSAT acquisition program if a lease arrangement is used."

General Electric Company

"At the outset, we will state that the General Electric Company is strongly opposed to any leasing concept for the STRATSAT Program. We shall summarize subsequently some specific reasons for this position. While stating our position in these terms to assure clarity, the General Electric Company's continuing strong interest in the STRATSAT Program is in no way diminished. We anticipate that the General Electric Company will remain a viable program participant and understand that this response will not be used to eliminate prospective bidders, as you clearly stated in your letter."

"The General Electric Company did not feel it was necessary, at this point in time, to commit the resources required to carry out, in meaningful detail, an analysis of the relative cost differences of a lease-vs-buy approach to STRATSAT. Such an analysis presumes a baseline

solution and fairly detailed understanding of the development and production costs. However, there are two more fundamental factors or issues."

"First, the ability to establish the insurability of a leased venture and to get any meaningful insurance cost parameters is extremely difficult in this very early time frame of program evolution."

"Second, the results of any lease-vs-buy cost analysis are highly variable, depending upon the ground rules and methodology specified or used."

"...it is our judgment that the extensive analysis carried out by the DCA/MSO in 1977 produced results supporting the 'buy' of DSCS-III that can be considered reasonably valid today. We firmly believe that more realistic economic considerations of: (1) inflation; (2) the cost of money to industry to support a lease venture; and (3) the need for industry to include risk capital in any formulation of lease costs, must be incorporated in any lease-vs-buy analysis methodology. In our judgment, these factors will more than offset any increase in discount rates (present value analysis) that may be considered. While this latter discount factor might tend to show leasing more favorably, proper introduction of the first three factors is expected to further reinforce previous analysis supporting the 'buy' scenario."

"Your letter introduced the concept of a hybrid approach, in which up-front development was considered in an open-ended 'buy' framework. This approach could remove some of the initial development risk and would reduce front end development financing (depending upon degree of 'buy' for development/qualification/initial flight verification). However, it does not significantly reduce the risk attendant to operational on-orbit performance and the insurability of the revenue stream. The hybrid approach does not change a basic factor that is counter to leasing in the first place, and that is the clear need for the military to control the day-to-day operation of the satellite communications system (and thereby remove control from the contractor-leasor)."

"In conclusion, the General Electric Company has evaluated over the past five years various satellite communications leasing situations (TDRSS, LEASAT, DSCS-III), and STRATSAT clearly stands out as a program that should <u>not</u> be a leased program."

<u>Hughes Aircraft Company</u>

"We have given this matter careful consideration and have concluded that a leased services offering, in either the pure or hybrid sense, would be inappropriate for this program."

"In the case of a 'pure' lease for STRATSAT as defined in the referenced letter, we believe that neither the current status of technology as required for the program nor the risk of on-orbit failure are sufficiently bounded to quantify a risk premium for inclusion in a lease price."

"Our summary assessment indicates that, for a 'pure' lease as defined, a responsible contractor either could not arrive at a logically derived lease price or would have to incorporate a risk premium of such a magnitude that the lease could not be economically advantageous to the government."

"This approach (hybrid lease/buy) to the acquisition concept in our opinion is only partially effective in reducing the real risk and consequent price premium inherent in the program."

"Although we have programmed algorithms for making such comparison, our judgment is that the consideration of risk and risk premium overwhelms our ability to resolve between various approaches. Moreover, considering the myriad of assumptions about terms and conditions which are not specified in the request, the possible number of cases to be treated is believed unmanageable. Based upon these considerations, we have elected not to include comparisons of this type at this time."

"Based upon considerations of 'pure' and hybrid lease concepts...and the status of the technological and operational art required to support the program, our current position is to decline to participate in the program under a lease arrangement acquisition concept. ... For the STRATSAT program the cumulative influences of: a) command/control and design flexibility to service vital national wartime interests; b) aggregate level of design and operational sophisticiation; c) shortfalls in time and funded program activities to allow realistic bounding of risk to the offeror; and d) probable risk premiums in any offering of a size which would negate any economic advantage to the government, lead us to conclude that this program is inappropriate for such consideration."

RCA

"On the basis of the Draft RFP, it is clear that the program will entail considerable development risk. The leasing concept would require the contractor to assume this risk fully, which violates the fundamental principle of not applying fixed price contracts to programs involving significant development risk. Additional risk would be involved in trying to establish contractually at the outset the respective responsibilities and interactions of the Air Force, NASA and the contractor in launching and controlling satellites that are not yet fully developed."

"Accordingly, RCA strongly recommends that the engineering design, development, production, and test of the first flight model be on a cost reimbursable basis. Subsequent flight models and operating services could then perhaps be on either a 'lease' or 'buy' basis, subject to certain conditions discussed below. Our assessment is that a 'buy' would probably be less expensive for the Government; however, as it is well-recognized, a 'lease' would relieve the 'front-end' financing burden for the Government."

"In carefully considering the lease possibility, it is important to note that Paragraph J of Attachment 1 includes the following sentence: 'No Government loan guarantees or progress payments should be assumed for these services.' If this is specifically meant to rule out use of the Federal Financing Bank, a contractor would be required to cover the full costs of developing STRATSAT with his own resources for a six year period before the initial payment for services would begin in FY 1987. At today's prime rate of over 17%, the cost of borrowing is over 20% when compensating balances are taken into account. Thus, full contractor financing for six years would more than double the cost of the STRATSAT system and impose a crushing financial burden on the contractor. We believe this provision can only serve to rule out the financial feasibliity of a lease based on normal commercial financing, since life cycle costs under such a leasing arrangement would be so much greater than an outright 'buy'."

"If, however, the resources of Federal Financing Bank can be made available, then much of the difference in cost to the Government in comparing lease vs. buy can be eliminated."

"Thus, if the Government is willing to pay the costs entailed in amortizing the high total price attributable to the commercial financing charges in a normal leasing arrangement, then RCA would seriously consider competing for the program, utilizing the resources of CIT. Also, RCA would seriously consider participation in the program if a Federal Financing Bank leasing arrangement could be utilized."

Rockwell International

"Rockwell International Corporation, Space Operations and Satellite Systems Division has performed an evaluation to determine the feasibility and practicality of the government to acquire the STRATSAT program through a leasing arrangement. The evaluation was made using a Rockwell developed lease/buy computer program to analyse and compare program to acquisition costs."

"The evaluation demonstrated that it is not cost effective or in the best interest of the government to lease the STRATSAT program. The analytical results showed the government cost to acquire STRATSAT through leasing to be 40% higher than purchasing."

"The primary reasons for the leasing option's higher costs, relative to purchase, is 1) the higher costs of risk financing and 2) the residual expense of the STRATSAT system (Government must continue to pay for the service at the end of the first five year lease period)."

"In addition to factors which the government must evaluate, certain considerations are critial to potential contractors in determing the advisability of bidding on a lease program of this nature. Such considerations are:

> The magitude of the investment required is so large in the context of the resources available to most potential contractors that participation without jeopardizing their financial health may not be possible.
>
> The large initial cash requirement and the length of time prior to the generation of positive cash flow in general characterizes an unattractive investment opportunity.
>
> The financial risks associated with technical failures, even if a failure is highly unlikely are so severe as to threaten the contractors continued viability."

"As a consequence of considerations of this nature, Rockwell International Corporation would not elect to participate in the STRATSAT program if it were structured on a conventional lease basis."

TRW

"Our conclusion is that none of the leasing arrangements, including the hybrids, suggested for STRATSAT is in the best interests of either the government or of spacecraft contractors such as TRW, and that a normal buy arrangement is approrpriate."

"TRW is not opposed to a leasing arrangement for military comsats providing two conditions are met that make the financial risks acceptable. First, the research and development content and technology risk must be moderate, without pushing the state-of-the-art. Second, the contractual terms and conditions must be consistent with sound commercial business practices."

"The projected high research and development content of STRATSAT does not meet the first condition for leasing stated above. This plus additional factors that cause leasing to be inappropriate for STRATSAT are summarized below.

(1) The undue financial risk in a 'total package procurement' for a high technology program (similar to the publicized C-5A experience of

several years ago) has devastating financial implications for the manufacturer.

(2) Large technology risks suggest a development phase contract different than the firm fixed price of a lease agreement.

(3) The STRATSAT orbit and mission seem to preclude the major cost benefit of leasing, namely spreading cost among more than one user, which proved so cost effective in MARISAT and TDRSS.

(4) The detrimental effect on both government and industry due to the probable reduction in spacecraft competitors in STRATSAT from the present four in a buy arrangement to one or two in a lease (as in TDRSS, LEASAT, and MARISAT), limited by the number of interested lessors.

(5) The difficulty in a leasing environment of enacting specification changes that would mutually benefit government and contractor, with attendant cost penalty to each.

(6) The greater STRATSAT cost of lease compared to buy, typically 1.6 times as much, according to our analysis using the GAO methodology."

"Because of the undue financial risks in a STRATSAT lease, TRW most likely would elect not to respond to a lease RFP."

Comsat General Corporation

"The philosophy and tenor of the concepts which you describe appear to provide, in general, a reasonable and workable framework and we are led to conclude that a lease of communications capacity can be developed which is quite attractive to both the U.S. Government and private industry. The program is however of such magnitude and complexity that simple answers and relatively simple programs such as our MARISAT/GAPFILLER lease to the Navy are not possible."

"You requested that we address the relative cost differences of a lease-versus-buy approach, and we have attempted to do so. I am sorry to say that we have been unable to develop any actual program costs for this specific case which we would judge meaningful and without the potential for considerable embarrassment to all concerned. I hope you will understand and appreciate that with a program complexity such as STRATSAT and the time which was available for study, the cost must remain undefined."

"On the positive side of the cost question, we see no reason why STRATSAT could not be as effectively leased as MARISAT/GAPFILLER with its benefits to the government and approximately the same cost ratios."

"I must underline the theme which I think I have made fairly clear in my comments that we do not regard the two-phase approach as being particularly efficient from either the cost or performance standpoints. If, for example, we were to propose a lease to you after having had no part or minimal part in the validation or development phases, we would of necessity regard the risk in guaranteeing performance as being much higher, thus price the service to you accordingly."

SUMMARY

A summary of these responses are included in Table XIV. A few conclusions can be drawn from these responses:

- o The spacecraft manufactures overwhelmingly feel that leasing is not a viable acquisition strategy for STRATSAT.

- o Comsat was the only responder who expressed that leasing was a viable option for STRATSAT. RCA would be willing to participate with Governmental support in the financing area.

- o If a meaningful cost analysis could be conducted, the lease cost would be higher than the buy cost.

- o The hybrid lease alternatives would help with the front-end financing but would not significantly reduce the overall financial risk.

- o The large financial investments required make the lease program financially unattractive.

- o The number of companies who would participate in a lease program is limited to one or possibly two.

TABLE XIV

SUMMARY OF CONTRACTOR RESPONSES

CONTRACTOR	PARTICIPATE IN LEASE	COST ESTIMATE	COMMENTS
Ford	Leasing satellites has not been part of Ford's business plan and they have no plans to change this plan.	None	None
GE	Strongly opposed to any leasing concept for STRATSAT.	Did not feel it was necessary to carry out, in meaningful detail, an analysis of cost differences.	Hybrid lease would remove some of initial development risk and would reduce front end development financing. However, it does not significantly reduce the risk attendant to operational on-orbit performance.
Hughes	A leased service offering, in either the pure or hybrid sense, would be inappropriate for this program.	A responsible contractor either could not arrive at a logically derived price for the pure lease or would have to incorporate a large risk premium and make it not economically advantageous.	Hybrid lease/buy is only partially effective in reducing real risk and consequent price premium.
RCA	Willing to participate if Government willing to pay costs of financing charges or use FFB.	A buy would probably be less expensive.	Strongly recommends that the engineering design, development, production, and test of first flight model be on a cost reimbursable basis. Lease or buy could follow.
Rockwell	Would not elect to participate in the STRATSAT program if it were structured on a conventional lease basis.	Government cost to acquire STRATSAT through leasing to be 40% higher than purchasing.	Large investment jeopardizes financial health of company. Large initial investment make it an unattractive opportunity. Financial risks threaten contractors continued viability.
TRW	None of the leasing arrangements suggested are in the best interest of either the government or spacecraft contractors and that a normal buy is appropriate. Most likely would elect not to respond.	Lease cost would be 1.6 times as much as buy.	The projected high research and development content is not consistent with leasing conditions. Lease would limit number of competitors.
COMSAT	Are led to conclude that a lease can be developed which is quite attractive to both the Government and private industry.	Unable to develop any actual program costs which would be meaningful.	Do not regard the two-phased approach as being particularly efficient from either the cost or performance standpoints.

APPENDIX A
GAPFILLER DESCRIPTION

Introduction

The GAPFILLER program was implemented in 1973 in order to provide interim UHF satellite communications service to the DoD in view of the demise of TACSAT I and the anticipated schedule delays in FLTSATCOM. A contract was awarded by the U.S. Navy to the Comsat General Corporation on 1 March 1973 to provide for the lease of a two-satellite UHF service beginning in 1974. Expansion to a three-satellite service was authorized in June 1976. This service was to be implemented by installing separate transponders on the MARISAT commercial spacecraft.

The communications payload for military use consists of a UHF receiver, three transmitters, and associated equipment. This provides two narrowband (25 KHz) and one wideband (500 KHz) channels. There are three GAPFILLER spacecraft in orbit over the Atlantic, Pacific, and Indian Oceans. All are operating although the Indian Ocean satellite has had two transponder failures and is operating on redundant transponders. Leased services commenced for the Atlantic in March 1976; for the Pacific in June 1976; and for the Indian Ocean in January 1977.

Funding

The originally quoted contract price for these services were:

$6.978 M per satellite per year for each wideband channel (500 KHz) and $2.326 M per satellite per year for each narrow band channel (25 KHz).

For continued service, these prices have changed substantially. As an example, FY 80 and 81 prices are as follows:

Atlantic/Pacific	Wideband Channel	$4.98M/year
	Narrowband Channel	$1.77M/channel/year
Indian Ocean	Wideband Channel	$2.58M/year
	Narrowband Channel	$ .86M/channel/year

Contracting

All services to be furnished would be requested by the Contracting Officer through the medium of Communications Service Authorizations (CSAs). The Government agreed to issue a CSA for the lease of one wideband channel for two years in each of the Atlantic and Pacific Ocean areas. The Government's obligation to pay for service ordered by any CSAs would begin seven days after Comsat has notified the Government of a channel's availability for Government use, or upon initial use of the channel by the Government, whichever occurs earlier. The Government's obligation to pay for service ordered would be based on the availability of the ordered channels which are not "unsatisfactory," as defined in the contract, regardless of how or whether these channels are used.

Termination Liability (by contractor)

Comsat had the right to terminate this contract without any liability to the Government if it did not obtain the requisite regulatory authorizations to enable it to provide the UHF services to the Government. Furthermore, Comsat had the right to terminate this contract without any liability to the Government if it did not obtain the requisite regulatory authorizations to enable it to provide L and C band services to other customers of MARISAT. If, however, by the 120th day

following of regulatory applications by Comsat, the authorization for [redacted] service to the Government had been granted and the authorization for [redacted] and C band services by Comsat to other customers has not been granted, then the Government would have the right to terminate this agreement without liability.

Termination Liability (by Government) Prior to Completion of Facilities

If this contract were terminated prior to the availability of the service, the Government's obligation to pay termination costs would be limited to those costs which Comsat is legally obligated to pay its contractors and which are attributable to the "wideband" channels of the satellites. However, in no event shall this amount exceed $27,912,000.

Termination Liability (by Government) After Completion of Facilities

In the event that the Government terminated this contract subsequent to completion of the facilities provided for in the contract, and prior to two years from the commencement of services in each of the two ocean areas, the Government would pay Comsat $13,956,000 for each of the two areas, less the sum of payments made for service which was ordered in each area prior to termination.

Except as set forth above with respect to the Government's commitment for wideband service for two years in each of the two ocean areas, the Government may terminate its order for channels, in whole or in part, at any time after service has begun without any termination charge, provided that it gives Comsat not less than 120 days written notice prior to the effective date of termination. In the event that the advance termination notice is less than 120 days, the Government shall be liable for and shall pay to Comsat a termination charge equal to the monthly lease charge for the channels being terminated multiplied by the number of months by which the actual termination notice falls short of the required

notice. In addition to the applicable termination charge, the Government shall be responsible for payment of the full lease charges in effect until the effective date of termination.

Reduction in Service Charges for Unsatisfactory Performance

The performance of a channel shall be considered unsatisfactory when:

o It fails; or

o Its performance fails to meet the specifications for a period of one hour or more; or

o For a period of one hour or more, it suffers intermittent failure to meet the specifications; or

o Any normal usage of the channel is disrupted for a period of one hour or more by any other malfunction of the spacecraft.

The monthly charge for each channel shall be reduced for any periods within a month that the channel was not satisfactory and was not used by the Government. This reduction shall be computed separately for each channel based upon the total time the channel was unsatifactory.

Launch Vehicle/Satellite Replacement Plan

Comsat was to purchase three satellites and the associated launch vehicles and services, and launch two satellites to provide service to the Atlantic and Pacific Ocean areas. The third satellite was to be used as an on-the-ground spare to replace a launch or in-orbit failure of either of the other two satellites as soon as possible after such failure. If the first two satellites were successful, Comsat would maintain the third and its launch vehicle in storage with a capability to launch within 90 days.

Comsat had the option of launching the third satellite at any time any deficiency exists in either of the other two satellites, whether or not such deficiency affects the channels provided to the Government. Comsat also has the option of procuring and launching additional replacement satellites at no additional expense to the Government, but shall not be obligated to do so.

Options

The Government had the right to exercise options to extend the lease period for wideband channels for a third year. The Government also had the option to lease a number of "narrowband" channels for a minimum of one year renewable for a second and third year.

Adjustments for Delay

For each day of non-excusable delay in meeting the service date in each ocean area, the Government's initial minimum commitment to purchase two years of service in that area shall be reduced as follows: for each day of such delay up to and including a total of sixty, the Government's commitment shall be reduced by one half day, and for each day of such delay in excess of sixty, the Government's commitment shall be reduced by one day.

APPENDIX B
LEASAT DESCRIPTION

Introduction

In the FY 1978 budget review, Congress deleted funds for FLTSATCOM spacecraft four and five, terminating the program after vehicle number three, "in favor of converting to a policy of leasing commercial satellite communications to satisfy this communications requirement." Congress has since approved a FY 78 supplemental request to fund FLTSATs four and five. The U.S. Navy, as the Executive Service, contracted for the LEASAT service from Hughes Communications Services on 1 October 1978. The LEASAT satellite will be purchased from Hughes Aircraft by a group of lessors. They will lease the satellites to Hughes Communications Service, who will, in turn, lease the communications service to the U.S. Navy.

The contract calls for five years of service from satellites at four orbital locations. Three of the four locations are to be primary locations requiring full-time service but the satellite serving the fourth location may be repositioned to cover an outage at any one of the other three locations. The availability dates for the fully operational satellites at the four orbital positions are: 1 April 1982, 1 October 1982; 1 April 1983, and 1 October 1983. In addition, all Tracking, Telemetry and Command (TT&C) requirements will be provided to support these four spacecraft for a period concurrent with the availability of the spacecraft.

Each satellite will provide 13 discrete communications channels using 9 transmitters as follows:

o A Fleet Satellite Broadcast (FSB) channel employing SHF uplink on-board processing, with UHF narrowband downlink (same as FLTSATCOM)

o A 500 KHz wideband channel at UHF

o Six 25 KHz narrowband channels at UHF, each using a separate downlink transmitter

o Five 5 KHz narrowband channels at UHF, all sharing a single downlink transmitter at predetermined power levels.

Funding

The negotiated contract price for these services is: $16.75 M per orbital position per year. The total contract price for five years of service at four locations is $335 M.

Contracting

Each annual increment of requested communication services is to be furnished by the Contracting Officer through the medium of Communiations Service Authorizations (CSAs) specifying the communications services desired. The Government agrees that commencing upon the availability of services, it will fund service from the four orbital locations on an annual basis.

Termination Liability (by contractor)

In the event the contractor fails to perform this contract or defaults in performance, the Government shall have no obligation to pay the contractor any amount.

Termination Liability (by Government)

In the event the Government cancels, in whole or in part, any of the services which the contractor is requested to provide under this contract, prior to the time such services are made available to the Government, or in the event that the Government terminates any of these

services, in whole or in part, after they are made available to the Government, the Government shall reimburse the contractor for the actual nonrecoverable costs which the contractor has reasonably incurred in specially providing facilities and equipment the use of which is canceled or terminated and for which the contractor has no foreseeable reuse.

Reduction in Service Charge for Unsatisfactory Performance

The performance of a channel shall be considered unsatisfactory when:

o It fails; or

o Its performance fails to meet the specifications for a period of one hour or more; or

o For a period of one hour or more, it suffers intermittent failure to meet the specifications; or

o Any normal usage of the channel is disrupted for a period of one hour or more by any other malfunction of the spacecraft.

An entire orbital position will be considered to have failed (services not rendered) if the number of satisfactory communication channels of any channel type included in the satellite design fall below the number indicated in the following table. Additionally, failure of the TT&C system to allow critical housekeeping and communications commands to be injected or their status to be monitored shall constitute failure to render service from an orbital position.

1 - Fleet Broadcast
1 - Wideband (500 KHz)
4 - Relay (25 KHz)
2 - Narrowband (5 KHz)

The monthly charge for each leased channel shall be reduced for any periods within a month that the channel was not satisfactory and was not

used by the Government. This reduction shall be computed separately for each channel based upon the total time the channel was unsatisfactory.

Delay (Government caused)

The Government has the right to delay the scheduled service date of each orbital position for increments of 180 days for a total of no more than two increments. In such cases the Government shall pay the contractor the sum of the payment of one month of service from one orbital position times 1.84 per satellite for each incremental delay.

Delay (Contractor caused)

For each day of non-excusable delay in meeting the service date set forth in the contract, the lease charge for those services to be provided by the delayed spacecraft shall be reduced by $10,000.00 per day delay to be deducted from the initial charges for that spacecraft. Though the starting date of the services is delayed, the contractor is still obligated to provide services for the full lease period for that spacecraft. In no event shall the reduction in lease charge exceed a total of $5,000,000.00 for all spacecraft. The Government reserves the right to extend the contract performance period set out in the contract on a day-for-day basis for all orbital positions the commencement of services from which was delayed on account of contractor caused delays.

GFE

The Government is providing substantial government-furnished equipment (GFE) both for on-ground testing and for implementation into the space and ground operating segments. This includes the satellite on-board processor which supports the fleet broadcast and command on board processing functions in the spacecraft, as well as the equipment used for security purposes regarding the TT&C.

APPENDIX C
TDRSS DESCRIPTION

Introduction

In December 1976 the National Aeronautics and Space Administration (NASA) entered into a lease agreement with Western Union Space Communications, Inc. to acquire services of the Tracking and Data Relay Satellite System (TDRSS) to carry out many of the functions now carried out by NASA's network of ground stations. TDRSS is to consist of communications satellites and a ground station to relay voice and data transmissions between mission spacecraft and users during the period 1980-90. The contractor will design, manufacture, operate, and own the equipments and the facilities which will constitute TDRSS. NASA will pay for the services provided in equal monthly installments over TDRSS' 10-year operational period which was intended to begin in January 1980.

Initially, three TDRSS communications spacecraft will be placed in geosynchronous earth orbit. Two of the spacecraft will provide operational communications service, and the third will be a backup in case of malfunction in one of the others, or in case of the need for increased capacity. A fourth spacecraft will remain on the ground as a standby in case one of those in-orbit fails. Two additional spacecraft are planned for manufacture during the operational phase to replace the initial four craft.

TDRSS is intended to provide nearly continuous communications with mission spacecraft at altitudes up to 12,000 km. NASA estimates the TDRSS will enable users to be in direct contact with the spacecraft a minimum of 85% of their total orbital times compared with only 15% for the present ground station network. The improved coverage will be due to

the geosynchronous orbits of the TDRSS spacecraft, which will always be in view of the ground station, and to the high altitudes of the TDRSS spacecraft (36,000 km.), which will be within view of mission spacecraft most of or all the time.

Funding

The fixed price for ten years of TDRSS service was $786.1M as of the contract signing on 22 December 1976. The contract included provisions for economic price adjustment in order to account for changes in escalation indices for periods prior to commencement of service. As of 12 December 1979 there had been 24 amendments to the contract resulting in a contract price growth to $870.2M. On 11 February 1980 William C. Schneider, NASA's associate administrator for space tracking and data systems, told the House Science and Technology subcommittee that continuing Shuttle delays have pushed NASA's estimate for TDRSS costs to more than $1.4 billion.

By letter dated November 3, 1976, to the NASA Administrator, the Federal Financing Bank (FFB) announced its intention to finance the TDRSS requirement. Western Union agreed to utilize the FFB in financing this contract. A failure or refusal by the FFB to provide funds, thereby making contract performance impracticable, shall, in the absence of a mutual agreement enabling performance to begin or continue, cause the contract to be terminated.

Provisions are made to permit the contractor to draw funds from the FFB during the construction period (from the effective date of the contract through 31 December 1979). In the event that service did not commence by 31 December 1979, additional interest accumulated between that date and the actual commencement of services would be added to the fixed price. Additional funds could be withdrawn from the FFB during the

post-construction period (1 January 1980 through 31 December 1980). Upon commencement of service, monthly payments will be made by NASA to the contractor equal to 1/120 of the fixed price.

Beginning on the effective date of service under this contract, the Government will evaluate the contractor's performance every three (3) months for a determination of the incentive award fee earned by the contractor. The contractor may earn a minimum incentive award fee of zero dollars ($0) and a maximum incentive award fee of $10,000,000 during the term of this contract.

Termination Liability

The parties agree that any termination settlement agreement must provide for the liquidation of any outstanding FFB loans to the contractor. Accordingly, the parties further agree that any termination settlement arrived at pursuant to the terms of this contract, will, as a minimum, be sufficient to pay the outstanding amount of any loans, including principal and interest, made by the FFB to the contractor which are secured by any outstanding assignment in favor of the FFB.

Contractor Termination

If the contract is terminated because the contractor fails to commence services or fails to make progress so as to substantially endanger the commencement of services in accordance the contract, the total amount otherwise payble by the Government shall be shared on a 50% basis with the contractor up to a maximum contractor liability of $30,000,000 less any amounts payable by the contractor pursuant to adjustments for delay. The contractor and subcontractors shall not be allowed a profit as part of any termination settlement resulting from a termination for the foregoing reasons.

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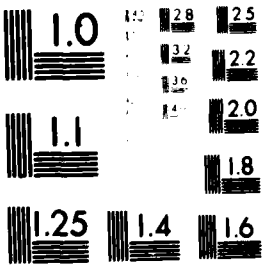

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Replacement Plan

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/e the right to use the in-orbit spare satellite for a
:s, in such a manner as shall not interfere with the
such satellite.

ly

tSS service did not commence on schedule due to
ie fixed price would be reduced for such failure an
/ the following schedule:

of Delay	Amount per Day	Amount per Month
ionths	$15,000	$ 450,000
ionths	$25,000	$ 750,000
months	$50,000	$1,500,000

in at a rate equal to the FFB rate on the financing of
iuted from the date the liability accrues until
itractor shall have the option of liquidating the

balance of such amounts in a lump sum payment including accrued interest at any time prior to the end of the ten (10) year service period.

In the event a scheduled launch is delayed due to causes not within the responsibility of the contractor, an equitable adjustment will be made which will include, in the case of a delay in service commencement, postponement of the application of these penalties for the period of such delay.

Shared System

Prior to the initiation of commercial services via the Advanced Westar portion of the shared system, the contractor may use the spare satellite for existing Westar system requirements and to provide experimental and occasional Advanced Westar services, provided that NASA service requirements shall always take priority over contractor requirements.

In addition, after initiation of Advanced Westar service, the contractor may use the spare satellite for Advanced Westar requirements, provided that NASA service requirements shall always take priority over contractor requirements. In the event the contractor uses the K-band portion of the spare satellite in revenue producing services, the contractor shall credit the Government for such use at an hourly rate equal to 50% of the hourly rate for the spare.